BULLETIN

OF THE

AMERICAN GEOGRAPHICAL SOCIETY.

Vol. XXVI 1894. No. 3

THE AMERICAN CAVE-DWELLERS: THE TARAHUMARIS OF THE SIERRA MADRE.

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My explorations in Northern Mexico extended over a period of three years. It was in September, 1890, that I entered, with eight scientists and assistants, the upper portion of the Sierra Madre, the Mexican prolongation of the Rocky Mountains.

In this first expedition we made excavations of the ruins near Casas Grandes, in Chihuahua. Several months were spent in the United States in 1891, and I then resumed operations in Mexico, following the Sierra from Casas Grandes to the border of the State of Durango, until the summer of 1893, and pursuing the work for the greater part of the last fourteen months wholly without assistance.

My first care on returning to the United States was to visit the Chicago Exposition, where I had occasion

to admire the superb reproductions of the Cliff Dwellings, which attracted and interested so many of the visitors to that great display; but I have been surprised to find, in various parts of the country, an accepted belief in the existence of cliff-dwellers at the present day.

This belief is in some measure due to inattention and to a confusion of ideas, though much of it must be referred to the reckless utterances of a traveller, lately deceased, to whose statements the anthropologists of America have for a long time ceased to attach any weight.*

Cave-dwellers are found among the following tribes, counting from the north: The Southern Pimas, the Tarahumaris (as well as the allied Varogios), and the Tepehuanes. All these tribes inhabit the State of Chihuahua, and are more or less mountaineers, living almost entirely in the great Sierra Madre range. Of these people the Tarahumaris are most attached to caves, the Tepehuanes the least. All are linguistically related, and belong to the Pima, or as Dr. Brinton terms it, the Uto-Aztec stock. In some of their customs and manners they also greatly resemble each other, while in others, as well as in character, they are strikingly different. Very little that may be called accurate was known of these tribes. The Tarahumaris, the most primitive of them and the least affected by Mexican civilization, are the most interesting, and I

* The allusion is to Lieut. Schwatka, whose fantastic story of the cliff-dwellers, discovered by him on the well-beaten Urique and Batopilas road, received the unmerited honour of translation into German in *Globus*, LXIII Band, S. 254–257, as a contribution to knowledge.—ED. BULLETIN.

shall confine myself in the following remarks almost exclusively to this ancient people, who may justly be termed the living cave-dwellers of the American Continent. Ancient remains are nowhere numerous in northern Mexico, and as soon as one enters the regions inhabited by Indians they almost disappear. Thus it is a rare thing to meet with old cave-houses; those found are of grit, always very simple and wretchedly small. The Indians of to-day attribute the majority of them to a mysterious people, the Cocoyomes, who were small of stature, did not till the soil, but ate each other and the Tarahumaris, or green herbs, and had other characteristics of the brute. While I have found corpses buried inside some of the houses said to have been built by the Tubares, a tribe now nearly extinct, the dead are commonly found in special caves quite numerous throughout the Sierra, and frequently disturbed by roaming Mexican treasure-seekers, who leave few caves untouched.

The natives rightly count only three seasons, namely, the dry, the rainy, and the winter. Snowfalls in winter are by no means unknown on the high land. The climate of the Sierra, although not so very pleasant on account of the winds, is extremely salubrious, the heat never becoming enervating, as it does not exceed 90 degrees, while the nights are deliciously cool. Lung diseases are unknown, and the sanitary condition of the Sierra is excellent.

Down in the barrancas, where the heat becomes at times excessive, the climate is very far from salubrious, and I have seen even Indians ill with fever and ague, contracted generally in the rainy season. Between

these two extremes, I have never experienced a more delightful climate than upon the slopes of the Sierra down towards the warm country. The air is pure and the temperature remarkably even. There is a story to the effect that a Mexican woman who settled in that part of the country broke her thermometer because the mercury never seemed to move, and she thought that it must be out of order.

The climate of the country as a whole is remarkably dry, and for the last two years there has been an unusual drought. As Indian corn will grow with a moderate amount of rain, it generally does well both on the high land and in the barrancas.

This country, thus comprising the high lands, the barrancas, and the wild slopes towards the west, is inhabited by the Tarahumaris, of whom the greater part live in the pine-clad plateaux. These people, who formerly had a much larger territory, are found between the latitudes of 25½ degrees and 29 degrees, from the pueblo of Temosachic south toward the border of Durango. Mexican civilization has long ago encroached upon their territory, and, even in the Sierra, Mexican ranches have absorbed the best part of the soil. However, in the central part these Indians still have absolute dominion, and no white man dares to interfere with the natives' right to the soil.

The tribe is little affected by civilization. Firearms are hardly known and they still use bows and arrows. Nominally Christians, they cling to their old beliefs, and are lapsing into heathenism. Some of them meet at the church on Sundays, to hear prayers, and on feast-days they mingle their heathen dances and sacri-

fices with semi-Christian ceremonial. Their churches are in ruins, and there is only one padre for the whole Tarahumari country.

A few of them speak a little Spanish, but the majority do not know that language; and in the most remote parts of the barrancas are found several thousand genuine pagans (called *Gentiles* by the Mexicans), who do not associate with the so-called Christians and who do not understand any other language than their own.

I selected as a base of operation a small Mexican ranch, called Guachochic (place of herons), whence I made excursions lasting from three to five months, and where I kept my stores of provisions and trading material, with such collections as I made. While travelling on the high land I used mules; in the barrancas I had to go on foot, hiring Indians as carriers. We slept under a stone or a tree, or wherever chance guided us, depending for food chiefly upon the Indians. My staple food for the last fourteen months has been corn,—corn in all kinds of Indian fashion, from corn-cakes (tortillas) to the grains simply roasted upon a broken piece of crockery over the fire. Having the happy faculty of liking most aboriginal dishes, I have often resorted to the herbs and roots eaten by the Indians in the cooked or the crude state, and have found some of them very palatable.

I experienced at first considerable difficulty in associating with these Indians, who are extremely distrustful of strangers. Frightened by some skulls that I had excavated, they took it into their heads that I was a cannibal, and lived entirely upon women, children and green corn. They used to disappear wherever I trav-

elled, so that at one time my task appeared almost hopeless. Fortunately, when I began my investigations alone, I had the good luck to start out with rain. The Indians had for months and months been praying and dancing for rain, which now, for some weeks, seemed to follow me. They soon associated my presence with the rain, and from that time on I was of good omen to them. They were now pleased to pose before the terrible camera, which, in their eyes, had become so powerful a rain-maker.

These people live in many different kinds of habitations, the variety of which is very remarkable. The majority use a kind of house consisting of a framework of four poles, on which rests a roof made of a double layer of split pine logs. Towards this framework lean the slanting walls of loose boards.

There are also regular log-houses, with doors, but no door-jambs. Where the climate is genial are found mere straw houses. Sometimes these houses consist simply of a roof of boards or thatch, or even earth, resting on four poles, or a lean-to without walls. In the pueblos the Tarahumaris live in houses made with stones and adobe. But in this country of weathered porphyry and interstratified sandstone, where natural caves and shelters are numerous, the Tarahumaris also make a free use of such habitations, to such an extent that they may be termed the living cave-dwellers of the American Continent.

Some of them are permanent cave-dwellers; for there are barrancas and arroyos where cave-dwellers may always be found; but most of the Tarahumaris are only temporarily so. The so-called Christian Tarahu-

maris on the high land live during the winter in the villages or pueblos, while they spend the rest of the year at their ranches in the mountains, living in wooden or stone hovels. Many of them do not come to the villages at all, as the missionaries taught them to do, but go into caves in the winter, *se encuevan*, as the Mexicans say. Thus in the neighborhood of Nararachic many Christians are cave-dwellers during the winter, but in summer most of them leave the caves for fear of the scorpions, tarantulas, "vinagrones" (*telyphorus*) and other pests which in the warm weather frequent the rocks. Within the memory of man, many caves have been abandoned for good, owing to the encroachment of the Mexicans upon the land of the Tarahumaris, the latter disliking the neighborhood of white men. As regards the pagans (Gentiles), who still in considerable numbers are found in the remote barrancas very difficult of access, they all love caves, but their mode of life is shifting. They plant corn high upon the crests of the barrancas in March, and when the rain begins in June and July they descend into the cañon to plant corn there. Subsequently they harvest, first upon the high ridges, then in the barrancas, where they retire for the winter to enjoy the warm temperature, living on the high land in wooden shelters, in the barrancas in caves, or under a big stone or a tree, as the case may be.

The heathen in the barrancas cultivates corn, beans, chile and tobacco, but upon a small scale, owing to the fact that the soil is scarce, and he has to build stone walls in order to retain his scanty supply, and add to it whatever the rains rushing down the mountain-sides

may bring. In that way small terraces (riffles) are formed, exactly of the kind to be seen so often farther north, in the Sierra and in the southwest of the United States, and abandoned ages and ages ago.

The greatest number of inhabited caves is found in the western part of the Sierra toward Sinaloa. It is seldom indeed that the caves are improved. I have, in a few cases, seen partitions of stone and adobe in them, but these never reach the top of the cave. The most common improvement is a loose stone wall in front of the cave, as high as a man's breast, as a shelter against the wind. The caves are rarely found in inaccessible places, like some in the United States. If they are difficult of access, they are made accessible by one or two wooden ladders, or rather notched trunks of trees. The caves are always found apart, at a distance of from one hundred yards to a mile or more. I heard of one arroyo where six can be seen at the same time, distant only from thirty to fifty yards apart; but this is a rare case. It is also rare to find more than one family living in the same cave; if so, the people are always near relatives.

When the caves are permanently inhabited, they are fitted up as are their houses, with the same utensils, the grinding-stone, baskets and jars. The fire is in the middle of the cave, and the floor is often cemented with adobe.

The storehouses, so necessary to the household life of the Tarahumaris for storing corn and clothing, are never missing in the caves. They are built of stone and adobe along the inner walls, and serve as big closets. The largest inhabited cave I have seen was

nearly one hundred feet in width, and from twenty to forty feet in depth. If the caves are very deep, the Indians live near the mouth. Never do they excavate caves or holes for habitations. These storehouses are quite an institution among the Tarahumaris, and are besides found everywhere in remote places, perched generally on high rocks or on boulders. Very often caves in places difficult of access are walled in and used as storehouses.

Although the Tarahumari is not nomadic, his life is shifting. He removes his domestic animals according to season, and plants corn in different localities, moving accordingly. On the highlands the Tarahumaris are certainly more permanent, and here the best wooden houses are found. Here they may even be found living in ranches of from five to six families. One ranch has at least twenty-five families, but even here on the high land a Tarahumari never lives all his life in the same house; if any one dies, the house is pulled down and removed. A peculiar custom among the Tarahumaris is that at night the father and mother will leave the house or cave to be taken care of by the children, while they go to sleep under a tree, in the shelter of the storehouse, or in some other cave, according to convenience.

The fact that people live in caves is in itself extremely interesting, but this alone does not prove any connection between them and the ancient cliff-dwellers, who lived in common, while the cave-dwellers of to-day are unsocial and isolate themselves. They are the old cave-dwellers who probably lived in caves long before the people of the Southwest, pressed by enemies, made

their remarkable homes in the cliffs and caves. To-day they still preserve ancient practices and customs, which other Indians have lost either wholly or in part.

Although the Tarahumari is very intelligent, he is backward in the arts and industries. His pottery is exceedingly crude, as compared with the work found in the old cliff-dwellings, and its decoration is infantile as contrasted with the cliff-dwellers' work. Moreover, he is utterly devoid of the architectural gift which resulted in the remarkable rock structures of the early cliff-dwellers. These people, so far as concerns their cave-dwelling habits, cannot be ranked above troglodytes.

The Tarahumaris, according to their own traditions, came from the north and east, the same countries as the Apaches, they say, and were placed in these mountains, the middle of the world, by their god, who put one cross where the sun sets and one where it rises. The cross in the east their god uses when he comes down to visit the Tarahumaris; that in the west is for the Tarahumari when he dies and goes to heaven. Between these two crosses lives the Tarahumari tribe. The Indians would like to go to the crosses and dance before them, one of their forms of worship; but they are prevented from doing so by large bodies of water, and they therefore all have small crosses standing outside their own houses, before which they hold their nightly dances. They also sacrifice before these crosses, and here is where their god comes to eat.

The Tarahumari of to-day is of a medium size and a dark-brown color. The people of the barrancas are smaller than those of the highlands. The Tarahumari is more muscular than most of our North American

Indians. Their cheek-bones are prominent and their expression is heavy. The woman is smaller than the man, but generally just as strong, and when angered by jealousy is often able to beat her man. They are rapid walkers, gliding smoothly along with quick steps, with the body very slightly bent forward, and without any swaying to and fro.

Both men and women wear long, flowing, straight black hair, in rare cases wavy, which they, like the southern Pimas, comb with pine-cones. It is held together with a woollen headband made for the purpose, or with a narrow plaited band of palm-leaf. Their teeth are exceptionally fine, and the canine teeth are not readily distinguished from the incisors. Beards are very rare, and if one appears, the Indians pull it out with great care. Their devil is always represented with a beard, and they call the Mexicans "the bearded ones."

The men wear a breech-cloth held up with a girdle, the women a petticoat and girdle, while in cold weather both sexes have tunics and blankets. The women are clever in weaving blankets, girdles and clothing on primitive looms lying on the ground. In contrast with most other savage races, these Indians are not fond of ornaments. The women wear hanging ear ornaments of mother-of-pearl and necklaces of grass-seed. The men may chalk ornamental designs on their faces and legs at the foot races, but few of them wear necklaces. A singular fact is that mirrors have no attraction either for the men or women; they do not want to look at themselves.

The Tarahumaris cultivate corn, beans, potatoes,

and also in the barrancas tobacco and chile (Sp. pepper). Their chief dish is what the Mexicans also use to a great extent, and call pinole—toasted corn, ground to a flour on a stone, and mixed with cold water. It is cooling and nourishing, but rather indigestible. As a luxury corn-cakes (tortillas) are eaten. From the harvest, which is in September and October, until February, the Tarahumari lives well, but starves from that time until the next harvest, subsisting chiefly upon herbs and the flesh of small animals, particularly squirrels and rats. A great many seeds, roots and the young shoots of the ash tree serve him for food.

In the dry season the Indian subsists almost wholly at times upon the baked heart of the maguey. This sweet stuff, which is also eaten with pinole, is to me frightfully indigestible. The Tarahumari likes to have meat every day, although he cannot always get it. He rarely or never kills any of his domestic animals for food, but goes hunting with his bow and arrow, and is also extremely ingenious in trapping animals. In order to get one squirrel, the Indians may cut down as many as ten pine trees, a whole day's work. They poison the waters of the rivers by means of the bark of certain trees, and also by herbs, stupifying the fish, but not making them uneatable. In the barrancas of the river Fuerte large parties of them may be seen fishing at night in this manner, observing several interesting ceremonies.

Later on in the summer, in places where the river is deep, they may be seen fishing with nets made by fastening some sixteen blankets together lengthwise with wooden splinters.

They are abstemious when at home, eating only twice a day; but when serving the Mexicans, they gorge themselves to illness. They generally rise at night, however, to eat and to play on the home-made violin, of the music of which they are very fond.

They show, even when in a starving condition, a remarkable endurance. An Indian has been known to carry a letter from Guazapares to Chihuahua and back again in five days, the distance being, as reported, more than 100 miles a day. In some parts, where the Tarahumaris serve the Mexicans, they are used to run in the wild horses, driving them into the corral. They will pursue deer in the snow, or with dogs in the rain, for days and days, until at last the animal is cornered and shot with arrows, or falls an easy prey from sheer exhaustion, its hoofs dropping off.

Their senses are keen, but in this respect they are not much superior to well-endowed civilized men. They certainly do not feel pain in the same degree that we do.

The Tarahumaris are very fond of heat, and may often be seen lying on their backs or stomachs in the sun. Heat never seems to trouble them. I have seen young babies sleeping with uncovered heads on the backs of their mothers, exposed to the fierce heat of the summer sun. In the pine regions, where they live longer than in the barrancas, it is not infrequent to meet men and women who are at least one hundred years old. Long life is what they pray for. Old people are many; their hair is gray, but they are seldom bald.

The attraction of these people is their wonderful

health, which may be looked upon as a matter of course in that delightful climate of the highlands. However, they are subject to pleurisy (*dolor de costado*), which generally proves fatal.

The Tarahumari woman is a good mother and takes great care of her children, of whom she generally has from six to eight, or even more, and she nurses them until they are three years old. A boy or girl is never punished, although often scolded. If a boy misbehaves, the father may reproach him at a feast or before one of his friends, and the friend may also talk to the culprit. The children are very independent, and if angry the boy may strike his father or mother.

The woman bears her child alone, and the husband makes no inquiry about the baby. When three days are over, the mother bathes herself, but the child is not washed until one year old. While she is bathing she leaves the little one naked in the sun, in order that he (the sun father) may recognize his newly-born son; and the baby is left thus, in spite of its wails, for about an hour. Then the shaman comes to "cure" it, so that it may become strong and live a long life, carrying it over smoke of the mountain cedar, three times toward each cardinal point and also three times backward; with a firebrand he makes three crosses on the child's forehead if it is a boy, and four if it is a girl.

As a rule, the Tarahumari is not a thief, but if he thinks himself quite unobserved and safe, and the temptation is very strong, nearly every one will steal. He never cheats, and is a pleasant fellow to deal with so far as honesty goes. He is averse, however, to selling anything, and considers it a favor. In fact, when

you succeed in making a bargain with an Indian, the mere fact establishes a species of foster brotherhood (when you and he call each other nanagua), and this facilitates later transactions. Time for consideration is thought absolutely necessary by the Indian. To buy a sheep requires at least two hours. In all bargains he always consults his wife, and even his children; and if any of them, even the youngest, objects, nothing can be done. To conclude a bargain about an ox may require three days. The almighty dollar has no power with most of them. The Indian has no need of money or of aught that money can buy for him, and he is swayed more by persuasion than by silver. He is rich when he has three or four cattle, with some sheep and goats. Silver Mexican dollars from outsiders are accepted in exchange for corn and other products, but among themselves a system of barter prevails. In most cases cotton cloth is preferred to dollars.

The Tarahumari is heavy and phlegmatic. His face is devoid of expression, and it seems at first hopeless to the traveller to get any information out of him. He is timid, and tries to run away at the sight of strangers, leaving his house or cave and its contents behind him. It is hopeless to follow, because the country is extremely rough, and they hide so effectually. When I travel I therefore always send an Indian to prepare the way for my arrival. The women and children are bashful in the extreme, which may be due to the sharp criticism and gossip common among them. Their chief trait is distrustfulness, but it may be overcome, although they seldom become absolutely trustworthy friends. They have no depth of character. Gratitude

is fairly developed. They are cowards when few in number, but if there are many, they know no fear. They are the only Indians who have held their own against the Apaches.

They are rather affectionate, but it is seldom that they show affection in public, unless when drunk. The Tarahumari is a polite personage for a barbarian, and has a word, "re-có," equivalent to "please," which he uses frequently.

Although they will give food to a stranger, if properly approached, they are not particularly hospitable, and there is no room in a Tarahumari house for a guest. If one Tarahumari visits another he never thinks of entering the house, but takes a seat on the ground, forty or fifty yards away. Nothing so angers a Tarahumari as the appearance in his house of a man unannounced. He might even kill the intruder. Only the dogs, they say, enter a house uninvited. It is not even polite to look at another man's house. So, if you want to get on well with an Indian, it is necessary to sit for at least a quarter of an hour near his hut, gazing into vacancy. Should the host be absent, the native visitor may sit near by for hours, and finally go away.

These people are devoted to foot-races, which are held the year round. They are poor, but they wager their bows and arrows, girdles, blankets, clothes, headbands, balls of wool, cotton cloth and beads.

At such races as these, two districts or pueblos always run against each other. Sometimes there are many runners on each side, and the two parties show in their apparel some distinguishing mark; for instance, one

side wears red headbands, while the other wears white ones. I have seen from four to ten runners taking part on each side. Each party has a small ball, about two inches in diameter, carved with a knife from the root of an oak tree, which they have to toss ahead of them as they run. The runner who happens to be ahead is the one whose duty it is to toss the ball with his toes, and at each toss it may be thrown a hundred yards or more in advance. They are not allowed to touch the balls with their hands, but their friends who follow them may point out to the runner where the ball is lying. The circuits over which the race is held are circular when the country allows; but generally the course is backward and forward along the top of a ridge, the group of spectators and betters being at the starting-point, which is always at the middle of the race-track.

In important races the runners may prepare for a fortnight, but as a rule they do not practice much before the race, for running comes to them naturally, as swimming to ducks. Their training chiefly consists in abstinence from native beer for two or three days before the event. On the day of the race the runners are fed with pinole only, they have tepid water to drink, and their legs are well bathed in warm water and rubbed by the managers. The shaman also rubs them with a smooth stone to make them strong.

In the afternoon before the race the managers (cho-qúe-a-mi) and the runners meet together, the latter bringing the balls with them to receive an omen as to which party is going to win. Water is put into a big tray and the two balls are started simultaneously

from one end of the tray to the other. The party whose ball reaches the other end first will be the winner, and they repeat this as many times as there are to be circuits, and bet accordingly.

There are, moreover, no end of supernatural devices and observances mostly in the form of witchcraft and charms, called to the assistance of the runners and to the injury of the opposite party. A race is never won by natural means. The losers always say that they were influenced by some herb and became sleepy on the race-course. Many remedies are brought to the contest to strengthen the runners and to weaken their rivals. There is no prize given, but it is the custom for a man who has been very lucky to give to the successful runner some light articles made from wool or cotton, but no money. On the day of the race stones are laid on the ground in a row, one stone for each circuit, and count is kept by taking away one stone for each circuit finished. It is from this practice that the tribe derives its name Tarahumari—from tará (count) and húmari (run)—people who run according to count.

Trees are marked with crosses, so as to show the circuit to be run, and watchmen are placed to see that no cheating is done. The women, as the runners pass, stand ready with dippers of warm water, or pinole, to refresh them. The wife of a runner may throw a jar of tepid water over him as he passes. Drunken people must not be present, nor pregnant women, because they make the runners heavy.

Most of the men and women follow the race, shouting to the runners to spur them on, and pointing out to

them where the ball is; and if night comes on they light resinous torches, and the race is continued.

A circuit may measure from 9 to 12 miles in length. They may agree upon from 5–20. Good runners make forty miles in from six to eight hours. The greatest runner I have heard of, could run from midday to sunrise. Women hold their own races, one valley against another. They do not toss the balls, but use a long wooden fork. At other times the women use a curved stick with which they throw before them a ring of twisted fibre. The game with rings is very ancient, and similar rings have been excavated from the cliff-dwellings.

The pivots around which the thoughts of these Indians move are rain and native beer. In their dry country rain is of the utmost importance for their crops, and without crops they do not get their *su-wí-ki* (beer made from maize). The Indian is inordinately fond of this, besides which he needs it for his ceremonies. No act of importance can be done without it. Su-wí-ki is given with the mother's milk to the infant to "cure" it. The dead get no rest without some of this beer being set apart for them, and it is the great remedy in the hands of the shamans, and never do they use it without first sacrificing a part to their god, who is as eager for this drink as they are. In making it, the moist corn is allowed to sprout, when it is ground and boiled, and the seed of a grass resembling wheat is added as a ferment. The liquor is put in large earthen jars, used only for this purpose, and is drunk when twenty-four hours old, or even sooner, because the jars are not strong. A row of these jars, inverted, is a

common sight outside of all Tarahumari houses or caves. The Indians drink incredible quantities of this liquor, which is white in color and resembles beer, and is called *tesvino* by the Mexicans, who also make it.

Dancing with the Tarahumari is a work to secure rain and good crops and to ward off evil. His word for dancing is *to work*, and the idle young men are frequently admonished by their elders, who say to them, "Why do you not go to work?" meaning: Why do you not dance? There are four or five kinds of dances practised. These imitate the motions of animals, and the songs implore the animal's help. The birds that sing in the spring, sing for rain. The crickets, the turtles, the fish, the frogs all help to make rain, and all dance. The deer, in the pairing season, taught them to dance their great dance, Yúmari, and the wild turkey taught them their other great dance, Rutubúri.

The first-named is a species of walk-around, in which the men forming a semi-circle and holding each other by the arm, march with lock-step, while the women in a similar concentric ring dance behind the men. Both men and women are wrapped in their blankets, the women often carrying their sleeping children on their backs. In the Rutubúri, the leader stands in the centre of a line, the men on one side of him and the women on the other; the dance consists in moving the line forward and then back, the women following the men at a little interval of time, for the place of the woman is always behind the man, although she is well treated, and her prayers have less value than his.

In dancing, men and women wear their blankets and

the women carry their children in the fold on their backs, where the little one sleeps through all the motion, its head rolling in every direction, but without accident unless the mother is drunk. It is to the sun and moon, their "high father" and "high mother," that they dance. An Indian seldom smokes in the daytime unless he is drunk, for he would offend the sun by so doing. The shaman, however, uses cigarette smoke in his prayers to the moon for rain. When at their dances, it is considered essential to observe a strict formality, to refrain from laughing or talking in a loud voice, and from making any unnecessary kind of noise. As it is difficult to preserve such decorum when large numbers of people are present, the pagans often depute one man to dance and sing as their representative, while the rest work in the fields. This lonely worshipper is doing his share of the work, and his dancing may go on all night. The Indians told me that such worship was exhausting, even to an Indian.

At the festival there is generally one singer who shakes a rattle in time to the melody or song, and who leads the dancing. Native beer and boiled meat are sacrificed or thown up with the dipper into the air towards the four corners of the world by the master of the house, first towards the east, then to the west, to the north, and the south.

Also very characteristic of the religious life of the Tarahumari is their plant worship. To the Indian everything in nature is alive, and even the plants could not grow if they had no soul. Many of them are supposed to talk, to sing, and to feel pain like ourselves.

There are five or six kinds of plants, species of mammillaria, or small cacti, called Híkori,* that live for months after they have been rooted up, and which are even worshipped. They look upon these plants as individuals, to be treated with the utmost respect, in fact as demi-gods to whom sacrifice must be offered. The chief benefit sought from this plant worship is the good health of the tribe, but there are also many other advantages to be gained by having the plants in their storehouses, or wearing them about their persons. Thus they drive off wizards, robbers, and Apaches, and make the eyes large so as to see the sorcerers. These Híkori are found growing in the ranges east of the Mexican Central Railway. When they are needed by the tribe, ten or a dozen Tarahumaris start out to gather them, first using copal incense and abstaining from certain dishes. They are very careful not to injure the plant in taking it up because the holy plant would get angry. Strange to say, although used for making an intoxicating drink, these Híkori are very virtuous and cannot endure the sight of anything wrong or lascivious. So they are kept in separate houses away from the Indian habitations.

The special shaman who devotes himself to Híkori worship draws with his finger upon the sand a mystical

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* Dr. Benjamin L. Robinson, Curator of the Gray Herbarium, Botanic Garden, Cambridge, Mass., has kindly determined the *hí-ko-ris*, as follows:

1. Muláto, *Mammillaria micromeris* (Engelmann).
2. Rosapári, a more advanced vegetative stage of the same species.
3. Sunamí is apparently a robust form of *Mammillaria fissurata* (Engelmann).
4. Híkori wanamé is *Mammillaria* (*Anhalonium*) *Lewinii* (Hennings).

figure, in the centre of which he plants the Híkori.* This he covers with a gourd, upon which he rests the end of a notched stick, which he rasps with a piece of wood, so as to produce an accompaniment to his song. Híkori is fond of noise, because "he" is powerful. While the shaman sings, a man or a woman is dancing before him, twirling on the toes. The ceremonies continue all night. If the shaman stops for a moment to rest, he asks permission of the Híkori, and formal salutations are exchanged. Híkori is a very important personage, and it is necessary to lift one's hat before approaching him; the Christian Tarahumari makes the sign of the cross. He is saluted as if he were a Tarahumari, with the formal and customary salutation, and is supposed to make the customary answers.

* My friend, Mr. Cushing, informs me that similar, almost identical, drawings are found depicted on the lava rocks of Arizona.

He says, in a letter dated October 30, 1893:

"The figure you sketch for me is closely allied, for example, to very ancient ritualistic petrographs in the lava regions of Arizona. You will see this at a glance by the figure of one of these petrographs, which I reproduce in juxtaposition to yours.

Tarahumari Medicine-figure. Mexico.

Ancient Ritualistic Petrograph. Arizona.

Others which I have recorded are even more strikingly similar, and when I come across them I will gladly make tracings of them for you.

I have always supposed that these figures were designed for 'medicine' ceremonials, but thought of them rather as pertaining to the medicines of the elements—wind, rain, water, etc., used in connection with sacrifices (with which ceremonial rites were terminated), than as connected with *actual* medicinal cere-

Once I wished to taste the Híkori, which was new to me. After a lively discussion I was told that I might sit with the shamans, on condition that I should take off my hat. It was a cold night, but I obeyed, and put on a handkerchief. The man who carried the gourd containing the drink danced with it in front of the shamans, then around the fire, and then brought it to me. It resembled in taste the Peruvian coca, but was not disagreeable, and although I drank but half a glassful, I felt it in a few moments. It made me wide awake, and acted like coffee, but was more powerful. This feeling lasted ten minutes, and was followed by depression, and a chill such as I have never before ex-

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monial. I was led to this belief by finding, in connection with some of them, little cup-shaped concavities pecked into the angles of the figures (as at *a a a*). You will observe that a line is drawn from the middle and straight portion of my figure, and coiled around the concavity at the right side, and that the terminations of the upper cross-lines are bifurcated around similar though smaller concavities. The entire figure represents a water-animal god, one only of a number of semi-human mythic monsters. For convenience, his heart is drawn out to one side, and within it is placed the cup of the '*chief*' medicine; while in his left hand is the cup of 'good' medicine, and in his right hand the cup of 'bad' (*i. e.*, '*strong*') medicine. If, in the light of this, you re-examine your figure, you will see with me, that it represents a MAN-GOD SITTING, his legs doubled under him, and his medicines distributed around and upon him according to his parts, and in accordance, also, probably, to their importance *and the case in hand.* He must always have the chief of all medicines placed on his heart as the 'renewer of life.' Then strictly with reference to the ailment to be treated and its location in the body or limbs of the patient (I should say) the other medicines. I throw this out as a suggestion, yet with much confidence in its at least approximate correctness, as indicated by my comparative studies. Probably a consultation of your notes and the remembrance of variations of the ceremony you have seen, will signify to you whether I am right or not. Remember that if these people have this ceremonial in connection with the treatment of disease, they will also have it in the treatment of *weather*, etc., when 'diseased,' so to say. You have opened up a new significance of many outlines among the older lava-remains, and if my record of these, in turn, has helped to explain your diagram, etc., you can judge of my pleasure and appreciation."

perienced. To get warm, I almost threw myself into the fire, but it was not until morning that the feeling of cold was conquered. Some of the Tarahumaris told me that they had been similarly affected, and could not take it on that account. Neither women nor boys are allowed to touch Híkori. At the end of four years it loses its virtues and grows mouldy, when it is buried in a corner of the cave, or is taken back to the place from which it came and new plants are obtained. In the eastern part of the Sierra and in a few other districts, for instance in the foothills around the river Fuerte, Híkori is not used at all.

When the Tarahumaris return with the Híkori, a whole night's festival, including sacrifice of sheep and goats, with much dancing and beer-drinking, is held in honor of the plants. The pile of Híkori, perhaps several bushels, is placed under a cross and sprinkled with beer. Híkori is sold to the Gentiles in the barrancas who are too timid to go for it themselves. One plant costs a sheep, and the buyer holds a feast in honor of its purchase, and repeats the feast at the same time next year.

There are several kinds of Híkori, of which I have brought back specimens. The commonest is Wanamé (Superior), which, besides being used to make intoxicating drink, is famous as a remedy for fever and for snake-bites and burns. It is also supposed to prolong life.

Sunamí, which is also used for making an intoxicating drink, is of much greater efficacy, but the greatest of them all is Walula salíami, literally meaning a great authority. This is a rare plant which I have never

seen. It is said to grow in low clusters, from eight to twelve inches in diameter. All other Híkori are "his" servants. "He" requires oxen for food, and therefore few of the Tarahumaris can afford to entertain "him," but the shaman goes to see "him." If an ox is not killed for "him," "he" will eat the Indian. "He" never dies, and is called the twin brother of God.

Without his shaman, the Tarahumari would be lost. Every Indian has his doctor, exercising also the office of priest, who looks after his health, and guards his body and soul against sorcerers and evil influences. When the shaman sleeps, it is only in appearance: he is always on the watch in the service of his people. He travels through the air, and visits God whenever he chooses, and talks with him. He cures diseases with herbs and other medicines, but also by supernatural means, especially by pretending to suck the maggots and bad blood, with the help of a reed, from the patient's body. These shamans agree with other scientists so far as to attribute all curable disease to the presence of bacteria, but bacteria of a larger growth, such as lizards and frogs in the stomach, and even snakes in the legs.

Virtuous as they are held to be, the priest-doctors may suddenly lose the light in their hearts when they grow old, and become evil-doers or sorcerers. I saw one not less than ninety years of age who was looked upon with suspicion and was in danger of losing his life.

People accused of sorcery, without having any knowledge of this crime themselves, are frequently whipped, and in recent times have even been burned. But there are also sorcerers who pretend to powers of witchcraft,

and are much dreaded. Such sorcerers can render people ill, or even kill them by their mere thoughts or by incantations with peculiarly shaped stones, the dried body of a humming-bird, the fore-leg of a frog, and so on. The same shaman may cure as well as kill.

The dead are wrapped in blankets and are buried in caves almost before they are cold. At the spot where the man died is placed food, and ashes are scattered that the tracks may show what animal came to eat. It is believed that the dead takes the shape of an animal for a year. During this period feasts are held, three for a man and four for a woman, to release the dead person from animal shape, and get him into heaven.

A bad man is only to be got into heaven by hard work, with sacrifices of beer and meat and much eating, drinking and dancing, to introduce first his head and graduàlly the rest of his body, but for sorcerers and for people who cannot pay the shaman there is no hope. Not even the sacred Híkori will release such persons from the beast shape.

In the heart of their territory the Tarahumaris are pure Indians, but those of the frontier are of mixed blood and speak Spanish. They are not diminishing in numbers, and the few who have had opportunities have shown capacity and ambition. A priest, whose charge is among them, assured me that he held some of them to be great men. However this may be, I have no doubt that advancing civilization will add to Mexico in these people thousands of honest and intelligent citizens.

FUR SEALS AND THE BERING SEA ARBITRATION.*

BY

J. STANLEY BROWN.

On the 30th of March, 1867, a treaty of sale was agreed upon between the Unites States and Russia, by the terms of which the former Government on paying $7,200,000 to the latter became the owner of what we all know as the Territory of Alaska. Included within that purchase were the Pribylof or Seal Islands—islands so small and so veiled by the mists and fogs of Bering Sea that it took the Russian mariners years of persistent search to find them. Although these tiny, barren scraps of public domain represent so few square miles that it seems as though they would have been overlooked in so gigantic a real estate transaction, nevertheless, their rock-bound shores have yielded the Government of the United States more dollars than were originally paid for the entire territory. They are indeed veritable treasure islands, well worth an hour's attention.

It is my purpose to say a word concerning these islands, geographically and historically, to refer at some length to the strange amphibians which find a congenial home upon them, and to recite the various phases of the

* Some of the statements in this paper have been published by the author in *Worthington's Magazine*, and acknowledgment is made to that journal for the courtesy of their use.

recent international contention of which they were the cause.

San Francisco stands about midway in the possessions of the United States, and when the traveller bound for the Seal Islands has passed from the Atlantic coast to the Pacific, there are yet 1,900 miles of ocean to be traversed to reach the nearest pass (Unimak) admitting him into Bering Sea, across the waters of which he must still go 200 miles toward the Arctic before he can hear the roar of the old "Seecatchie" upon the shores of the Pribylofs. The end of his journey will find him in about the latitude of northern Scotland, and 500 miles due south of Bering Strait.

There are two routes to this far-off land—one straight away to sea, the other *via* Sitka. The former is neither eventful, interesting nor instructive. After a few days the grateful, sparkling sunshine of the Golden Gate is exchanged for a leaden sky and a humid atmosphere, and the last half of the ten or twelve days' journey is often made in a persistent, sullen fog, which enwraps everything in its chilly folds. There is no danger, as in the Atlantic, from other vessels, but there comes to the novice a slight nervousness when he reflects that in this fog the vessel is headed for a barrier of islands pierced only by narrow passes; that deflecting currents are constantly at work; that proximity to the shores is often to be determined only by the uncertain process of "running up" the ship's time, and that upon the rock-ribbed coast he is approaching there are none of civilized man's appliances for warning the mariner of danger.

The captain must "pick up" the land as best he can,

and feel his way cautiously through the passes. Unless the last day is a rare one of sunshine the scenery which meets the eye is distressingly gloomy; high snow-clad peaks and frowning rocky walls are on every hand, but after having buffeted the waves and endured the depressing fog of the past fortnight, the restful sensation which steals over one as the vessel glides through the calm waters of sheltered Unalaska Harbor is felt by even the tarriest of old salts. The black beetling crags and the treeless towering heights are still present, but the houses of the North American Commercial Company and the little Aleutian village of Unalaska, presided over by the Alaska Commercial Company, nestle at their feet, and in this far north land, still bleak and barren in the transformation of winter to spring, the sight of these touches of life and civilization brings to the heart a glow and to the mind a relief which enable one to enjoy once more what is really scenery of unusual grandeur. When the fog caps lift there can be seen to the eastward the smoke of Akutan rising majestically heavenward; looking westward a glimpse is now and then had of the sunlit snowfields which ever enshroud the summit of lofty Makushian, while on every hand volcanic cones and rugged peaks spring from the water's very edge, giving an effect not unlike that to be seen on Lake Geneva upon a misty day. This effect may be heightened by the presence of animal life, far up the mountain sides, for though Campbell—a better poet than naturalist—was in error when he sang of "The lone wolf's howl on Unalaska shore," the introduction of reindeer there is an accomplished fact, and from a picturesque standpoint alone,

the little band makes a charming addition to the landscape.

Fortunately a little steamer now carries the mail monthly from Sitka to Unalaska, and if you contemplate studying seal life take the advice of one who knows: First arm yourself with a Government permit and then visit the islands *via* the inland passage to Alaska, thus having the delights of one-half of the journey to compensate for the miseries of the other.

The story of the discoveries in this northern region is one of the most thrilling in the annals of history. While in these days we are busy sending parties into the Arctic, we sometimes forget the valuable explorations which have been initiated within its limits. The discoverers of the Kamchatkan coast, the Aleutian Archipelago and the islands of Bering Sea came from the northwest *via* the Arctic Ocean. As early as 1646 the Russians in northern Siberia had reached the Colyma River, which flows into the frozen ocean, and two years later they made their way coastwise through Bering Strait into Bering Sea. In their cockle shells of crafts explorations were continued along the shores until 1715, when the first sea-going vessel made a voyage to the west coast of Kamchatka. In 1725 Peter the Great planned a most ambitious expedition which, owing to his death, was carried out in 1728 by the Empress, who made Captain Vitus Bering the commanding officer. In a somewhat desultory manner Bering continued his explorations until 1741, in which year a more elaborate expedition was sent out. Two vessels were outfitted at Avatcha Bay, on the coast of Kamchatka, and sailed southward and eastward. Bering

commanded one and Cherekoff, his subordinate, the other. The occupants of these vessels endured the most heartrending suffering through exposure and disease, accomplished the remarkable feat of sighting the North American mainland without more than catching a glimpse of the Aleutian Archipelago, and finally on the return voyage Bering discovered the one of the two islands of the Commander group which bears his name, and died there very shortly after.

The survivors rebuilt their vessels the following summer and made their way to the Kamchatkan coast.

The Commander group, discovered by Bering and composed of Copper and Bering Islands, is a possession of Russia, and forms one of the two fur-seal centres of Bering Sea, the other being the Pribylofs.

The furs brought back by Bering's sailors, especially the beautiful highly prized pelts of the sea otter, at once fired the cupidity of the Russian traders. In vessels that were little better than planks lashed to timbers and corked with moss, these uneducated but daring mariners cruised hither and thither; and though actuated solely by the most sordid and often basest motives, and though committing crimes the wantonness and brutality of which forbid recital, they nevertheless added much to the knowledge of the land areas between Kamchatka and the Alaskan mainland. The discoveries of these lawless and licentious "promishleniks" ended in 1766, but hardly a year followed in which exploring parties were not sent out. While many of them were official and for the purpose of contributing to the sum of geographic knowledge, the majority were bent on finding new localities where

the valuable sea otter was yet unexterminated. But the time came when the geography of the Aleutian Archipelago and adjacent shores was made out, and nearly all the sea otter haunts were invaded. As this favorite fur became rarer and rarer, attention was more and more turned to the fur seal of the north, especially as the fur seal of the south was nearing extermination, and mismanagement had curtailed not a little the yield from the Commander Islands. The Russian navigators had repeatedly noted seals in abundance in the passes of the archipelago and the neighboring waters—journeying northward in summer and southward as the winter approached. Where were the breeding grounds? This was the question which puzzled explorer and fur hunter for years previous to 1787, at which date the long search was crowned with success. As to the exact time and place of discovery authorities differ, but it is quite certain that between 1786 and 1788, nearly fifty years after the finding of the Commander Islands, the islets which make up the Pribylof group were located by the Russian officer after whom they were named.

Volcanism must be held accountable for the origin of these islands. In the past it was an important agent of change throughout that whole region, and vestiges of this mighty force may still be seen, *en route* to the islands. If the vessel will vary the direct course a little to the westward, one catches a glimpse of Bogoslov, a little knot of rock thrust up above the sea within historic times, and which in its declining days still breathes out columns of steam.

St. George, a compact island some eleven miles long and five or six miles wide, is first met in the route of

travel. Its black precipitous cliffs towering up from three hundred to a thousand feet give the appearance of a gigantic slice of rock set upon a watery plain.

Thirty-six miles to the northward is the other member of the group, St. Paul, with its two tiny outlying companions, Walrus and Otter Islands, mere dots of rock. St. Paul is a little larger than St. George, but in outline and general aspect it is in striking contrast to its neighbor. Approximately it stands just as created by the lava flows which built it up; the areas adjacent to the shores are comparatively low, while bold cliffs are infrequent. St. George, on the other hand, as has been said, presents on nearly all sides perpendicular walls of rock and only occasional low-lying shores are to be found. On St. Paul there are many reaches of sand beach, and though most of the shores are covered with basaltic rocks and jagged boulders of all dimensions, nevertheless the slopes are gentle and the seals can readily withdraw from the assaults of the surf which would otherwise threaten the life of their young. On St. George there are only three areas where the scant shore is not flanked by inaccessible cliffs, and the natural consequence is that St. Paul can, and does, support a far larger seal population than St. George. On the former there are no less than ten rookeries, while on the latter there are but five, and the rookeries on St. Paul are, in area and in seal population, much greater than those of St. George.

As one approaches either island the thought naturally arises that it would be difficult to find an inhabited land in greater contrast with sunny California, left but two weeks before. The shores are sombre and repellent;

there is no evidence of agriculture, and no trees lend picturesqueness or softness to the landscape. The prospect from the seaward side is certainly not encouraging, but on landing these first impressions give way to more agreeable ones. One finds, both on St. George and St. Paul, neat, well-kept villages, a cordial welcome, generous hospitality, all the comforts and some of the luxuries of life and most interesting problems for study. A humidity bordering on a "Scotch mist" is continuously in the air, but there is after all a tonic in this briny, sodden atmosphere, and one cannot resist its invigorating, stimulating influence. Now and then there is an approximation of sunshine, which is all the more enjoyable for its infrequency. If there are no trees there are flowers—the rounded, undulating volcanic cones and vents of St. Paul, and the rugged bluffs and plateaux of St. George are covered with them in the wildest profusion; and there is no more inspiring walk in the world than across the mossy meadows and up the gentle hill slopes, while on every hand thousands of brilliant blossoms peep through the waving grass. Nor are the walks along the shore less inviting. One can sit for hours on some favouring ledge and look down upon the seals which perform, more gracefully than a fish, endless evolutions in the clear water below, or watch the aquatic birds which here find a most congenial home. The cliffs are covered with them and they dot the water everywhere. There are sea parrots with brilliant beaks and crests, sea quail of more modest plumage, beautiful kittiwakes which circle in graceful spirals above the intruder, glossy-breasted long-neck shags, and "arries" that stand in solemn grotesque

files upon every available crag, while "choochkies" in flocks of thousands literally cover the rocks and furnish endless sport for the village urchins who capture them in nets.

The one object of absorbing interest, however, whether viewed from the standpoint of a naturalist, an idle spectator, a native inhabitant, or a business man, is seal life.

The fact that both the Commander and the Pribylof groups are isolated, free from the incursions of predatory animals, and are in moist northern latitudes, may have influenced the seals in the selection of their home, but the real cause must always remain more or less a matter of speculation. We know that over the land and water there brood continuously throughout the spring and summer the cool yet bracing fogs so characteristic of the North, and, despite what seems such uninviting meteorologic and topographic conditions, these remote, rock-bound, fog-drenched islands are the seals' chosen resort. The more jagged and irregular the lava fragments that cover the shores, and the more continuous the drenching they receive from the moisture-laden atmosphere, the better the seals seem to like it. More than half the life of this amphibian is spent either upon or about these islands. There it is born, there it first learns to take care of itself in the water, and to its birthplace it annually returns with unerring certainty. So attractive is this combination of rocky shores and perpetual moisture, so essential to its existence is its annual return, and so compulsory is this firmly fixed habit, that in order to comply with its demand it traverses thousands of miles of water, completing one

of the most extraordinary migratory circles known in the animal kingdom.

There are a number of expressions current upon the islands with which the novice soon becomes familiar. A categorical statement of them will add somewhat to a clearer comprehension of some of the features of seal life. Females are "cows," and their young are "pups." The natives call the former "matkie" and the latter "kotkie"—the singular being "matka" and "kotick." The young males from one to five years of age are "bachelors," or "holluschickie," while the old mature males are "bulls," or "seecatchie." There is a class of males which in age and size are between the "bachelors" and the "bulls." They usually have wigs, or patches of hair, on their shoulders, and they are called "wigs," "half bulls," or "polseecatchie." It is from this class that the ranks of the breeding bulls are recruited.

The places occupied by the seals upon the islands are called "rookeries," and they are made up usually of two parts—"breeding grounds" and "hauling grounds." The former explains itself; the latter is an area out upon which the young male seals, from one to five years old, haul themselves when they leave the water. The breeding grounds are usually among rocks of all sizes and shapes, while the hauling grounds are often upon a sandy beach some distance away. No hard and fast rule can be made, however, for there are cases where the breeding grounds are more or less sandy, and the configuration of the land compels the immature males or bachelors to haul out immediately in the rear of the family circle. This right on the part of

the bachelors is well recognized, lanes being left free for them to come and go so long as they keep to the straight and narrow way. Any deviation from the path of rectitude, however, is promptly met by an assault from the old campaigners, before which the inexperienced youngsters shuffle off in dismay. An episode illustrating this fact still somewhat troubles my conscience. On the islands photographic opportunities must be promptly utilized. Such an occasion occurring, I one day hastened to a position at the back of a rookery to secure a picture which I had long wanted. I found the ground occupied by a half bull, a handsome young fellow, who was evidently loitering about with flirtatious intent, or possibly to have a brush with his elders, that he might develop the needed strength and courage to make him their worthy successor. This "polseecatchie" contested the ground with me at once, but by the vigorous use of rocks, aided, doubtless, by the realization on his part that he was an intruder, I finally induced him to retreat a little, and before he could recover himself one of the old bulls was upon him. Unaccustomed to such an onslaught, and bewildered by the attack, he made the mistake of crossing the rookery instead of retreating landward. He literally ran the gauntlet of half a dozen old bulls, not one of which failed to leave his teeth marks upon him. His blood quickly covered the rocks, and a crimson trail followed him as he swam away. Fortunately, by reason of their thick blubber, such wounds are not dangerous, and, despite the salt water, heal with remarkable rapidity.

In late April or early May the bulls first make their

appearance. Each one on coming ashore pre-empts a little rocky claim upon the breeding ground, and here for eighty or ninety days, without food and water, and resisting even to the death the encroachments of all intruders, he seeks to establish and maintain his household. Throughout this period the bulls are the embodiment of ferocity, and, without the slightest hesitation, attack one another or anything else that comes within reach. Of this I had the most convincing proof. Wishing to secure a good photograph of one of the rookeries, I procured a small boat and crew and was rowed to Sea-lion Rock, a few hundred feet off shore. Although our intrusion was vigorously resented by some old homesteaders, who made the air resound with their harsh cries, we succeeded in effecting a landing. A prominent ridge of rock attracted my attention as a coigne of advantage, but to reach it it was necessary to scramble between two old bulls who glowered at each other through some thirty feet of space. Literally enveloping myself in folding camera, kodak and tripod, I made a rush over the huge slippery boulders, quickly passed between the bulls before they realized the situation, and the rocky steep was reached without accident; but to my horror two more great creatures arose from behind the rocks of the summit to give me warmest greeting. In the meantime the two in the rear had closed in somewhat to have a shy at each other, or to pay me delicate attention on my return. Matters were becoming complicated. Forward I could not, so backward I must go. In making the downward scramble my thick boots, joining forces with the slippery rocks, played me a shabby trick, and I found my-

self with battered knees full length among the boulders and flanked on either side by two huge beasts which, like the "beaver" in "The Hunting of the Snark," were "gallumphing" toward me. The situation was not one to inspire confidence, and it pains me to be compelled to confess that, temporarily abandoning photography and apparatus, I sprinted on all fours as rapidly as possible, calling lustily to a sailor to strike one of them with a boat-hook. To my intense relief, and in violation of a special United States statute, he, by a well-directed blow, brought blood and confusion to the cranium of one of my assailants. The wounded brute was instantly taken undue advantage of by two of his murderous brethren, which seized him by the throat, and all three rolled down a slight declivity. In the meantime my bruised members had served me well and I was out of danger. The misfortune to one of the combatants enabled me to recover my photographic outfit in a more stately and dignified manner, and—it was not a good day for amateur photographers—I re entered the boat and returned to the village.

If an artist cared to paint a picture symbolizing utter loneliness, it is doubtful if he could find a better subject than an old bull seal, without food, without water, patiently keeping his watch day after day on a barren rock on the bleak, surf-beaten shores of the Pribylof Islands.

These old males are from three to four times larger than the females, and are the most unattractive of all the seals, but despite their grotesque form and clumsy gait, there is something majestic about the great creatures as they rear their crests to make a pass at an

intruder, or to utter their curious clucking cry of invitation—a call doubtless dear to the heart of the female seal—when, after thousands of miles of travel, she approaches the shores of her home.

In very late May or early June the vigils of these patient old solitaries are rewarded by the arrival of their prospective consorts. If there had been previous differences of opinion over property rights, there now arises lively and sometimes fatal contention—contention the fury of which is naturally dependent upon the size of the seal herd—but which suffers no abatement until about the middle of July, when the last comer has arrived. The seal household has been very appropriately named a "harem," and its numbers may vary between the extreme limits of one and seventy-five, though the latter is rarely reached, and a fair average would be from twenty to twenty-five. In seal life every year is leap-year, and though the contrary is usually believed, the size of the harem depends largely upon the popularity of the old "seecatchie," for the "matkie" exercise the right of selection. The explanation of this is simple when it is remembered that they are in the water while the keepers of the harems must remain on land and are kept to look after their claims. When, however, the female has come out of the water, snuffed about as though trying to recognize the spot, and with unfeminine boldness advanced to the harem of her choosing, then the lord and master places himself between her and the water, exercises rigid control, and is most insolent and domineering in his demeanor. If the slightest appearance of straying is manifested, he, despite the rocks and boulders which thickly cover the ground,

courses rapidly around the entire harem, angrily shaking his head in disapproval, or he may take a short cut across the harem itself, scattering mothers and pups to the right and left. The contentions over their consorts rise, after they become members of the harem, not usually when they are *en route* to it, and much of this contention is more apparent than real. The passages at arms are certainly frequent, the attempts at wife-stealing numerous, but actual combats are rare, and forays are not usually successful. Nevertheless, as one lies on a convenient ledge above the seals, screened from their view by the tall, soggy grass, yet so close that the color of their eyes can be noted, the enactment of some very dramatic episodes may be seen. It seems incredible that these apparently clumsy creatures, weighing from three to four hundred pounds, can move so quickly. The action of one of his neighbors excites the suspicion of an old "seecatchie"; instantly his head is raised, and the two with glowing eyes, and regardless of the jagged intervening rocks, plunge toward each other. When within range a watery vapor issues with a sibilant hissing sound from their nostrils, the head and neck are projected forward with a fierce lunge; the body at the same time flattens itself upon the rock, and the attempt is made by each antagonist to seize the throat of the other or the flesh just behind the fore flipper. Frequently this is only bravado and nothing comes of it; but occasionally a flipper is caught in a fierce grip, and instantly the fangs of the other combatant are fixed in the neck of his opponent; then without a sound, these giants shake each other like dogs until their frames quiver with rage and ex-

citement, but there is no relaxing of the relentless grasp until the flesh or hide gives away. Then the assault may be renewed with increased vigor, or, their outraged honour being satisfied, they sullenly retire.

On another occasion you may see one of the huge beasts in the twinkling of an eye make a sudden dash forward, seize a female by the back and lifting her clear of the ground go "galumphing" away, apparently unincumbered by his hundred-pound burden. If his comrade in the other harem is too quick for him a great gash may be the price paid for his temerity. It is not unusual to see a sturdy old campaigner with half a dozen unhealed wounds, or minus a lower lip, and now and then a female with teeth-marks in the form of a rent, in back or side.

By the side of each matka, soon after her arrival, is seen her one progeny, which has the appearance of a New Foundland pup with flippers. It is difficult, however, to grow accustomed to hearing a cow baa like an ewe and her "pup" respond with the bleat of a lamb. Much affection is manifested by the mothers toward their young, and I have seen them take their little ones, when but a few hours old, by the neck and tenderly lift them from crevices between rocks in which they had helplessly fallen, much after the fashion of a cat carrying a kitten. It is not until the pup is some weeks old that it is able to recognize its mother, but, in common with all the members of the animal kingdom, the mother possesses the power of selecting her pup from among the hundreds by which it may be surrounded. For about two weeks after landing the mother does not stray from the harem. By this time the demands of

her growing offspring make it necessary for her to seek the sea for food, and in its quest she will travel as far as two hundred miles from the islands. It is one of the pleasantest sights on the breeding grounds to see a reunion of mother and pup after one of these expeditions.

After the first two weeks the pups grow active and become voracious feeders, but when once gorged with milk they can live for several days in comparative comfort without further nourishment, and may even resist starvation for two or three weeks; for a creature that can abstain from food and water for eighty or ninety days, under severe physical strain, must transmit to its offspring unusual powers of endurance. The pups require maternal care as late as October or November, or until about the time of leaving the islands in the fall. Cod-fish furnishes the bulk of the mother's food in Bering Sea, and it is obtained doubtless without difficulty wherever the fish is found as a surface feeder, for the "matkie" are among the most quick-moving of all creatures that swim in the sea, and they easily outstrip their finny prey.

As previously noted, the cows begin to arrive early in June, and hence the breeding grounds expand until about the 10th or 15th of July, when their maximum extension on compact orderly lines is reached. Hardly is this period of culmination attained, however, before disintegration sets in, and the pups play no unimportant part in bringing it about. It is true that other forces are at work also, but just the moment the young seals are sufficiently mature to wander about, the normal arrangement of the breeding grounds begins to be

lost. As *paterfamilias* does not interfere with the amusement of the little fellows, they first gather in groups or "pods," roll and tumble in play, imitating their elders in their infantile contentions, and soon attempt little journeys of exploration. Then the disintegration of the harems is rapid, for the control of the head of the house is slight when pitted against the plaintive bleat of the hungry offspring. The impotency of his authority is evident at a glance, and his antics in endeavoring to preserve the autonomy of his household are often ludicrous. One by one his consorts slip away, and soon this now thin and emaciated pinniped, who ruled in lordly majesty and grandeur, is left to his own reflections. His fierce courage has oozed away, he no longer seeks to assault whoever and whatever crosses his path, but timid and with lowered front, he shambles away from the intruder, a picture of melancholy and dejection.

Late in July or early in August the pups will have gathered in crowds at the water's edge, where, in a favoring cove or between large rocks which break the force of the waves, their swimming lessons begin. Rare instances have been noted by trustworthy observers of mothers compelling their young to learn to swim by taking them in their mouths, carrying them a short distance from the shore and there leaving them "to sink or swim." This is unusual, but there is no doubt that they are timid at first and disinclined to venture in, and it is quite certain that the majority of them learn to swim much as do "little wanton boys," first in the shallows near the shore, then among the more boisterous waves. It is not until after much practice

that they have learned to dive beneath and through the combing breakers, be they great or small, that they are able to guard themselves from destruction against the rocks, and even then if the surf is very high their strength and skill are not sufficient to save them from destruction. In the fall the flesh of the pup is considered a great delicacy by the natives, but the killing of pups for food has been abolished by the Government since 1890.

What has thus far been said has referred to the breeding grounds. Other events not less interesting have occurred on the hauling grounds. Until a male is six or seven years old he cannot successfully compete with the relentless old veterans which year after year have established their harems. There is, therefore, a large number of male seals, ranging from one to five years, whose lives would pay the forfeit of any attempt to go upon the breeding grounds. The bachelors form this class. They make their appearance about the middle of May.

On arriving at the islands they make their way, as before stated, to the hauling grounds, where, if undisturbed, their time is spent in sleeping or frolicking in play after the fashion of dogs, and thoroughly enjoying life in their own peculiar way. If left to themselves, the bachelors would enter the water only at long intervals, for their younger life is a period of training to enable them to endure the long fasts which they will have to undergo later. It is evident that through this natural sorting it is possible to round up and drive away, without interfering with the breeding grounds, bands of these young killable males, which furnish the

marketable pelts. Interference with the breeding grounds has never been permitted by the United States, and the killing of a female is a misdemeanour with heavy penalties attached. These three or four year old bachelors furnish the seal skins, and it is from them that the best garments are made.

As the fur seal is polygamous the taking of a reasonable number of young male seals under intelligent supervision, and the careful preservation of the breeding grounds from molestation or interference, cannot injure the rookeries any more than the selling of steers and the reserving of cows can impede the growth of the stock-raiser's herd. The driving and killing of the bachelor seals is the important annual event upon the islands.

In these northern latitudes during the summer season there is light for 18 to 20 hours. Early in the morning—the exact time being determined by the distance required to drive the seals—the natives repair to the hauling grounds from which a drive is to be made. With the breeze to the windward, they creep noiselessly between the herd of young males and the water's edge, and rising up simultaneously, start the frightened creatures landward by the clapping of hands or other noises. Once away from the shore and headed in the direction required, it is not a difficult matter to drive them slowly to the killing grounds. Their awkward, lumbering gait and the necessity of resting them every few minutes, make progress very slow. On arriving at the killing ground, which is usually adjacent to a shallow pool, the seals are driven into the water and allowed to cool off. The killing

usually begins at six or seven in the morning, or even earlier if the day threatens to be warm. Armed with a stout oaken staff about six feet long, and made specially for the purpose, the experienced clubber begins the work. Under direction of their chief, or the company's agent, and in the presence of the resident treasury officer, there are cut out from the general band small "pods" of from twenty to thirty seals, which are driven a short distance away, and as the desirable ones are noted, one swift, skillful blow by the clubber upon their thin skulls robs them instantly of life. The undesirable ones are returned to the nearest water, the dead are quickly drawn to one side, turned over and pierced to the heart with a keen-bladed knife by the younger natives, who are not yet full-fledged sealers. They also, after the seal is bled, make a single cut the entire length of the body from chin to tail, and also make one sweep of the knife around the muzzle and fore and hind flipper. The carcasses are next taken in hand by the "skinners," the most skillful laborers on the islands. With a knife sharpened to razor keenness by a specially prepared whetstone, they remove the skin of the seal in less tnan two minutes. "Pod" after "pod" is driven up and soon the field is covered with hundreds of glistening carcasses, their unskinned muzzles, black flippers and white blubber in which they are enveloped making a form in startling contrast to the sleek and graceful creatures, which looked appealingly at their pursuers from their beautiful gazelle-like eyes a few minutes before. Every incident of the killing field is most distressing to one in the slightest degree sensitive. While the death of the

creatures is painless, the array of quivering, bleeding forms, with eyes often protruding from their sockets, after the fatal blow has been struck, makes a picture offensive to look upon, unpleasant to recall, and surpassing in all its sickening details the horrors of an abattoir.

The last act in the drama is performed by the women. They repair to the field and after removing with knives the fore shoulders and any other edible portions, including such tidbits as the hearts, livers and tongues, transport them to the houses in leather bags slung from their shoulders. There the meat is cut into strips, subjected to such drying as the moist weather permits, and ultimately put with fat into the prepared stomachs of sea lions and stored away for winter use. The flesh of the seal forms one of the native's staple articles of diet, and if properly cooked is a palatable and nutritious food.

While these harpies have been hovering over the carcasses, wagons have been busy transporting the skins to the salt house. It is almost easier for a rich man to pass through the needle's eye than to secure a seal skin illegally from the islands. A Government officer counts the skins as they are taken from the field each day, he counts them as they are loaded into the great skin bidarrahs for transportation to the vessel, which takes them to San Francisco, and they are again counted when they reach that city.

When the skins are first brought to the salt house, they are laid out flat in bins or kenches and covered with salt, special care being taken that the edges are well cured. A few days later they are made up into rolled bundles of two skins each, face to face, then

stored in the company's warehouse until the close of the season. When that time arrives they are transported in great skin boats or bidarrahs, capable of carrying ten tons, to the vessel which lies in the offing, and which is to transport them to San Francisco. On arriving there they are placed in water-tight casks and shipped at once to London, where nearly all the seal skins of the world are not only sold, but converted by means of the following process into an article which can be utilized by the furrier. After the salt and oil are removed from the skins they are flensed or pared down on the back until the roots of the long outer hair are shaved off, thus permitting the latter to be readily plucked out. There remains only the highly prized under fur. The next step is the dyeing. This is done by hand, and in the case of first-class skins, the color is pencilled on time after time, until an enduring and satisfactory shade is obtained. This hand work is an important factor in the costliness of seal skins. The seal skins from the Pribylof Islands, or Alaskan skins as they are known, are the choicest furnished to the fur markets of the world.

What has been said thus far refers only to the seals at their homes; they have a most interesting career at sea. As the rigors of winter approach in these northern regions, it becomes necessary for the seals to seek warmer waters, and a surer and better food supply. Doubtless the thoughts of the seals, if they have any, turn with satisfaction to the more agreeable temperatures and the dainty fish which swarm in myriads along the northwest coast. Late in August and in September the old "seecatchie" and "polseecatchie," and pos-

sibly some of the larger bachelors, will have started on their way to their winter feeding grounds south of the Alaskan Peninsula. In the latter part of October the great mass of seals—the mothers and their young, together with the "holluchickies"—will begin slipping away also, not all at once, but gradually, and usually by the end of November the last of them will be on their way toward the passes of the Aleutian chain, following in the wake of their comrades which have spread out over the Pacific Ocean to the south of the Archipelago, and are steadily moving eastward.

The departure of the seals upon this wonderful migratory tour is greatly influenced by the weather. Were it favorable, doubtless they would remain upon or around the islands all winter; and indeed killing of seals has been made there as late as January 27. It is usual, however, for them to make their appearance off the coast of California in the early part of December. What pickings, scant or otherwise, they get in the great ocean, we do not know, but the herring, smelt, and eulachon, which swarm along the shores, make abundant provender for them. The pups, which left the islands pudgy in form, silver grey in color, and unfamiliar with the terrors of the deep, have been buffeted by the stormy waves of adversity, and have gained knowledge and self-reliance. The natives of the Aleutian chain, who found them easy prey when blown by adverse winds into the little bays and coves, would now have difficulty in catching the slender, active, black creatures, which appear smaller than when they left the islands, and which dart with the speed of an arrow among the schools of fish.

Slowly the herd makes its way northward along the coast, urged by the unerring instinct and compelling necessity of return to their home. It is now that the sea hunter or pelagic sealer gets in his deadly work. For centuries the natives of the Northwest Coast, as each spring rolled round, fitted out their hunting canoes and captured with spears the seals, which then, undeterred by the noiseless, primitive methods of pursuit, came close in shore. The white man learned of the natives, and in turn substituted another method. His more intelligent mind devised not a better, but a surer way of getting a greater number of seals—a more certain way of working the destruction of the goose which lays the golden egg. By fitting out schooners they were enabled to follow the herd in-shore and off-shore, and pursued it from start to finish. For the silent weapon of the Indians they substituted the noisy but more effective shot gun, more effective because it can be placed in the hands of a much larger number of hunters.

When early in January the Makah Indians are getting a few seals off Cape Flattery, the whites are busy overhauling the sealing fleet. The number of seals which would be taken by the Indian hunters in their canoes, off-shore, in the old days was comparatively insignificant, and when their prey had once passed beyond the narrow limits of their territory they were safe from this source of destruction; but the white men, with their little schooners of from fifty to two hundred tons, keep relentlessly on the track of the migrating herd as it moves along the coast.

The most opportune time for taking seals is during

the calm weather following a storm, when, tired of buffeting the waves, they are sleeping on the surface of the smoother water. Natives in canoes and white men in boats are employed in the pursuit, and each favorable day these small crafts are sent off from the schoon ers, returning at night with such of their prey as they may have secured with spear, rifle or shot gun. The best locality, both as to weather and abundance of seals, is after the southern half of the North Pacific course has been traversed. In April or May the schooners are attacking the herd as it moves along in the vicinity of Prince William Sound, Cook's Inlet, and Shelikof Straits, and on past the Shumagin and Shannak Islands, while in the first days of June the sealers will not only make them run the gauntlet as they go through the Aleutian chain in the vicinity of the passes, but if permitted would still carry the chase into Bering Sea and continue the hunting until the gales of early September put a stop to it. In this method of taking the seals no selection can be exercised; the slaughter must, in the very nature of things, be indiscriminate. The pups less than a year old, the bachelors of all ages, the mothers, faithfully bearing through thousands of miles of sea the burden which the laws of Nature have laid upon them, all alike fall before the weapons of their destroyers. It is within safe limits to say that there is hardly a month of the year when the seals are not the object of assiduous attention on the part of man. From Cape Flattery to the Pribylofs, through thousands of leagues of sea, they are hunted, not only by their natural enemies, the sharks and killer whales, but with spears and fire-arms, while on the very threshold of

their chosen home the oaken staff of the seal clubber awaits them. Their only friends are the boisterous waves, their guardian angel, the howling blast.

I trust the foregoing has given some idea of the general facts of seal life. In a few paragraphs I desire to call attention to the dangers which beset it and to pass on to the measures of relief proposed by the Tribunal of Arbitration.

There are but two groups of seals to furnish to the world its supply of seal skins—the fur seal of the north, and the fur seal of the south.

When Sir Francis Drake circumnavigated the globe in 1577–80, the Arctocephalus, or southern fur seal, was to be found at no less than thirty localities, and their numbers aggregated millions.

To-day, the contributions of these southern waters are from three resorts, and do not usually reach 15,000 skins annually.

When Vitus Bering, in 1741, stumbled upon the Commander Islands, and Pribylof searched out in 1786–87 the group which bears his name, there were discovered, not only the chief breeding grounds of the northern fur seal, Callorhinus ursinus, but some of the most superb rookeries the world has ever known. It is questionable if mortal vision ever rested upon more magnificent display of seal life than was to be seen on the Pribylof Islands when first visited by man.

To-day these sub-Arctic resorts are prostrate; their glory also has departed and they furnish a home for but a mere remnant of the seals which formerly swarmed in myriads along their rocky shores.

What agency has been at work to destroy a creature

so peculiarly adapted by its habits to man's management? It occupies no territory, needed, as were the buffalo's feeding grounds, for the subsistence of more valuable domestic animals; no herders are required to prevent its getting lost in the wastes of the ocean, and no expense is incurred, either to protect it from the inclemency of the weather, or to provide a winter food supply, yet with more certainty than the ranchman's flocks and herds seek the home range, do the seals annually return to their breeding grounds, where, under wise and proper management, they can, without injury to the parent stock, be made to yield a profit equal to, if not greater than, that derived from the cattle of the plains or the sheep of the mountains.

Turning first to the fur seals of the south, we find that some little interest was manifested in their capture as early as 1690, but it was not until the close of the last century that their pursuit was begun in earnest. Hardy mariners, stimulated by the hope of sharing in the profits of the fur-trade which the Russians had developed with the Chinese, searched out the resorts of the southern fur seal; ravaged them year after year, in season and out of season; regardless of age or sex, slaughtered the helpless creatures with clubs on land; gathered a harvest of 16 or 17 million skins, and by 1830 had practically destroyed in the southern seas this valuable fur-bearing animal. If all these resorts were in their original condition and under wise and prudent direction, they could easily supply to the fur-trade annually something like half a million skins, with a corresponding advantage to an army of skilled artisans. As it is, *indiscriminate killing* has left only the

Lobos Island rookeries at the mouth of the La Plata River and a few insignificant resorts at Cape Horn and the Cape of Good Hope, the total yearly yield of which is, as before stated, less than 15,000 skins. The two great resorts of the northern fur seal are the Pribylof and Commander groups of islands in Bering Sea. Robben's reef, a rocky islet in the Okhotsk Sea, has a small rookery, and a few localities of minor importance are found along the Kurile Islands. While the Russians prohibited all interference with their possessions from outsiders, their own treatment of the seals was similar to that practised by the sailors in the south. No attention was paid to sex, season or period of procreation, and it was not long before the end came there just as it had done in the southern seas. The Russians were taught by repeated and severe lessons that the only way in which the rookeries could be restored and perpetuated was to protect the females from death and the breeding grounds from molestation. This course, accompanied by practically a suspension of killing during certain years, was rigidly adhered to, with the result that when the rookeries of the Pribylof Islands were turned over to the United States in 1867, their condition, instead of being one of exhaustion as in those of the south, approximated that which existed when they were first discovered. It is thus apparent that man, through the exercise of wisdom and moderation, can maintain the rookeries at, or when depleted, can develop them again to the highest numerical limits permitted by the operation of Nature's restrictions.

From a commercial standpoint these islands have amply repaid the care bestowed upon them. The

flippant remark is often heard that "the game is not worth the candle," but it should be remembered that, although there are but four of these northern localities and Russian mismanagement from time to time played such havoc with them that the catch was an uncertain quantity, still they have contributed to the fur-trade since their discovery between five and six million skins, or about one-third as many as have been furnished by the southern resorts. From the time the fur seal of the south ceased to be of commercial importance, trade has relied upon these rookeries of the north. Thanks to the more enlightened policy employed by the Russians, and adopted and improved upon by the United States, so far as its islands were concerned, they furnished to commerce during the twenty years ending with 1889, a uniform yearly quota of nearly 150,000 pelts, which formed the basis of, and made possible the systematized seal skin business of modern times. As a raw commodity they sold for an average of two and one-half million dollars at the annual London trade-sales, and during that time the Pribylof quota yielded the Government of the United States in revenue many more dollars than were originally paid for the entire Territory of Alaska. The value of raw seal skins is now about fifteen dollars for skins taken at sea, and thirty dollars for Pribylof skins. At the present revenue rate, if it were possible to take the same quota as was secured up to 1890, the Government income from this source would be nearly one million dollars annually.

The seal skin industry is of no mean proportion, and the first profit on the raw skins indicates but roughly its magnitude. These peltries must be gathered in

remote regions; they form part of the transportation business of railroad and steamship lines; coopers must make casks for their shipment; they must pass through the hands of many laborers before they reach the forty buyers in London who purchase them and the 2,000 skilled artisans who convert them into fabrics suited to the use of the trade, and when all this is done there must still be stores maintained and clerks employed in order that they may find their way to the wealthy consumers. The labor incident to the taking, transporting, manipulating and disposing of these peltries demands the employment of thousands of persons each year, and when we recall the prices paid for these skins when converted into the garments dictated by fashion, it will readily be seen that it is an industry the ultimate value of which is represented by millions of dollars annually. It is a peculiarly worthy industry, in that it gives occupation to many, while the profits come from those best able to pay them. "On every ground the game is well worth the candle."

This career of the northern rookeries and of the in dustry based thereon, suffered a check some ten years ago when on the American side of the Pacific indiscriminate killing was again put into operation, through pelagic sealing, or the taking of seals at sea by means of weapons. At the very start pelagic sealing promised to prove as effective as did the sailors' clubs upon the southern resorts. Its promise has been most generously kept, and from its deadly though partially controlled effects the rookeries are now suffering. Indiscriminate killing, when practised on land as in the south, or at sea as in the north, produces the same

result, the destruction of the rookeries. No race of animals producing but a single offspring annually can long survive an attack which involves the death of the producing class, the females. I am aware that there is another side to this question, and that England and Canada hold the theory,—which in justice to them should be stated, that the decline of the northern rookeries was due to *excessive killing* on the islands, pelagic sealing being a factor of only secondary importance. If this theory meant that after pelagic sealing had made serious inroads upon the Alaskan seal-herd, it was excessive killing to continue taking the annual quota of 100,000 skins, it would be a sound one, and the United States to that extent would be culpable, but England and Canada would not accept this limitation; they wanted their theory to account for a much larger share of the burden of the destruction. They fail, however, to sustain their theory, until they show by clearest proof that the decline of the rookeries begun prior to the development of pelagic sealing, and get rid of the awkward fact that for the first 12 or 15 years of American ownership there was no difficulty in securing the annual quota allowed by law. Why did this alleged decadence through excessive killing on land take so long to manifest itself? Certainly the evil of indiscrimination is not inherent in land killing; on the contrary, selection can be exercised at the rookeries as readily as it can be at the abattoir, and there is no more necessity for molesting the females than there would be for a farmer to ship all of his herd to market and have the selection of the killable males made at the stock yard.

Can any one successfully maintain, that in the case of polygamous animals, the taking of the surplus male life and reserving the females can destroy the herd? If this can be demonstrated, then our stock-raisers are at fault, and the evidence derived from Russian management goes for naught.

Before the breath of life can be breathed into this theory of decadence through excessive killing on the islands there must be removed from the record books certain well-established facts concerning the perniciousness of pelagic sealing. It will be necessary to dispose of the fact that while in 1878 there was one vessel engaged in pelagic sealing, the number steadily increased, until in 1892 there were a hundred and twenty-two to follow on the migration track of the herds, to harry them eight months out of the twelve, and, if permitted, to accompany them to, and even upon, their chosen resorts. There must also be a successful refutation of the fact that there is a loss through sinking of not less, and probably much more, than 10 per cent., inherent in the method of taking seals at sea; that pelagic sealing strikes at the very life of the rookeries, by killing 75 or 80 per cent. of the females, more than half of which are mothers whose death involves that of their unborn offspring; and that the period of gestation occupying nearly 12 months, a mother killed in Bering Sea means that three seal lives pay the penalty. It is equally important to the maintenance of this theory that there be an elimination of the fact that during the four seasons ending with the past one of 1893 there were taken on the Pribylof Islands only 50,000 skins of young immature males, while during that same period

there were actually marketed by the sealers over 200,000 skins, which represented only about half the injury done the herds—an injury which fell heaviest upon the producing class—the females. Until these records stand impeached it is idle to charge the decadence to excessive killing on the part of the United States, or to seek obscure and improbable explanations for the present depleted condition of seal life.

It has only been profitable to follow this branch of the question to show that the destruction of the seal population of the world has been due to the taking this amphibian by methods in which selection was impossible, and to point out what might be expected from pelagic sealing whenever and to whatever extent carried on—the amount of injury being limited only by the magnitude of the enterprise. Improprieties on land can be guarded against, but the disastrous consequences of pelagic sealing are inherent in the business and are beyond man's control. The injury can be lessened, but only through the curtailment of the number of seals taken—the co-efficient of injury to the herd is a constant one.

In following the career of an animal possessing such capacity for self-perpetuation and ready adaptability to uses of man, the student of natural history and of economics is appalled at its wanton and needless destruction. Man's pursuit is as pitiless as it is stupid and a great nation wrangles and invokes the canons of law for the right to complete its annihilation. As to the seal's future we must turn to what comfort we may find in the decision of that court of recent, if not last, resort—the Paris Tribunal of Arbitration.

The causes which led to the arbitration are familiar to all. Pelagic sealing originating in the North Pacific, was carried into Bering Sea, and finally extended to the Asiatic herd which frequent the Russian or Commander Islands. The Government realizing the peril of our rookeries from the assaults made by the pelagic sealer upon the seals when upon their migration, attempted to avert its evil consequences, at least partially, by seizing schooners in Bering Sea. Each year it was hoped that, at least as far as those waters were concerned, the danger would cease, but each year it increased as the vessels multiplied and the skill and knowledge of the sealers became greater. The continued seizing of schooners by the United States met with remonstrance on the part of England and finally, after much mutual irritation and heat, became the subject of diplomatic negotiations, the peaceful outcome of which was the Paris Tribunal.

Three duties were entrusted to the Tribunal of Arbitration. It was to settle certain jurisdictional questions, to decide the question of property right, and in the event of the matter being left in such shape that the concurrence of Great Britain was necessary to establish regulations for the purpose of protecting and preserving the fur seal, it was to frame such regulations as would be applicable outside of the jurisdiction of the respective Governments, and to indicate the non-territorial waters over which these regulations should extend. As it is not important in this connection to consider the jurisdictional phases of the case, we will for the sake of brevity turn at once to the property question and the regulations—the two points that immedi-

ately concern us; the former from the standpoint of general interest, and the latter by reason of their intimate relation to the future of the seals.

The able representatives of the United States took the position that the Tribunal was bound by no precedents and possessed, by virtue of its origin, a creative as well as a judicial function. They urged upon the Tribunal the taking of high ground and the settlement of the question upon broad and comprehensive principles. They pointed out that man by means of invention was rapidly extending his dominion over the water as he had over the land, and by employing methods which were not even dreamed of when many existing municipal and international laws were enacted, threatened the very existence of many creatures useful to man. They showed that this creature possessed in a high degree an *animum revertendi* which had been utilized for the establishment of an industry, and that the habit had been promoted by refraining from acts likely to discourage it, and that under the operation of the principle of ownership through the utilization and promotion of the habit of returning, the United States possessed certain well-defined property rights. Turning from the citation of voluminous authorities vindicating the justness of their claim of property right in the seals and in the industry, they pleaded with sturdy argument and great eloquence that the Tribunal would fail in its high duty did it not lend its aid to such an extension of the world's idea of property right as was needed to meet the demands of the advancing age. They asked that the narrow ground be not taken, that this great Tribunal was called into existence solely for

the purpose of settling a dispute between two nations, but that it was given an opportunity and was vested with the power to make a substantial contribution to international law, and that its verdict, while disposing of the immediate matter in dispute, should be such a formulation, upon broader lines, of our conception of rights, of property and of protection as would be of value to all mankind, irrespective of nations. They pointed out that the material progress of the world was based upon the fundamental principle of ownership, and that the most effective way of preventing the commercial annihilation of certain great groups of creatures was by lodging in the nation best qualified by its geographical position to protect them, a custodianship, to be exercised over them for the benefit of all. It was shown that the adoption of this principle would dispose of the question of the relation of other Governments to the subject; would make possible the rehabilitation of many of the seal-rookeries of the south; that it would protect such industries as the coral and pearl fisheries, and that it would be useful in controlling the rapid inroads man's ingenuity is now making on the denizens of the sea. In short, it would be a direct, useful and common-sense way of settling the whole matter.

With equal skill of argument and eloquence of address the advocates of Great Britain and Canada held that the Tribunal possessed but one function—that its duty was to declare the law and not to make it, but that, whatever its function might be as an international body, it was not vested with the power to make international law, but must keep to the straight and

narrow way of settling a contention between two nations, and adjusting two conflicting methods of catching seals. They asked that the Tribunal provide for the continuation of pelagic sealing, under the sanction of law and under the most favorable conditions consistent with the carrying out of the terms of the treaty. True, nothing was said in the treaty about preserving the business of pelagic sealing, but before so patient and generous a Court it was not difficult to inject it as an issue into the question of preserving the seals and continuing pelagic sealing, and to take up a large share of the proceedings with pleadings in behalf of the latter. They demanded that the question of property right be settled from the standpoint that the seals were wild animals—*feræ naturæ*—which man could only reduce to possession by killing. They insisted that the law relating to wild animals, regardless of its origin, had been accepted by nations as the years ran on; it was very old law, and very good law, but whether good or bad it was the law, and from its teachings as enunciated by them the Tribunal must not allow itself to be enticed away by the seductive citations and insidious argument of learned counsel on the other side. There must be no making of laws to suit new conditions; the old standbys must be adhered to rigidly whether applicable or not. They urged that the seals were wild animals, and denied that the United States had done anything except of a negative character to encourage or develop in them the *animum revertendi* —the habit of returning to their homes, as in the case of bees and similar creatures—and thus had lost their claim to a property in them; and if the world, or a part

of it, desired to turn out in boats and to destroy the industry by shooting the seals in the water, they had a perfect right to do so, for a wild animal was free to all. No matter if seal mothers roaming the sea for food did fall before the guns and spears of the pelagic hunters and their helpless pups starve on the rookeries, the hand of the slaughterer must not be stayed, for the United States had no rights any one was bound legally to respect when the seals were three miles off-shore, while, as for humanitarian considerations, they had no place in the controversy. Suppose the pups, which do not leave the land until months after birth and which are totally dependent upon their mothers during that time, do perish, thereby injuring an industry which for a century had been carried on unmolested and unquestioned, this Tribunal, they insisted, had no authority in law to furnish relief by declaring a property right in the seals or in the industry dependent upon them. They urged as a last appeal that if the Tribunal contemplated disregarding the law and settling this question on lines of their own choosing, it must refrain from doing so, because it would interfere with that wonderful invention, the immemorial privileges of the high seas—an interference which nations would actively resent, and would thus thwart the whole object of the arbitration.

The Tribunal, true to the conservatism of the Old World, accepted this interpretation of their powers, recognized the potency of venerable legal relics, assented to the arguments of the counsel for Great Britain and Canada based thereon, and contented itself with deciding that the United States had no rights of

protection or property in the fur seals or the industry based thereon.

The next task to which the learned Tribunal addressed itself was the framing of regulations. In making an analysis of these regulations I do not mean to indicate that they do not represent a victory for the United States. How great a victory it was is best appreciated by those familiar with the personal equation of the continental arbitrators. These regulations furnish the last hope for the preservation of the fur seal as a commercial commodity. It is not probable that any other nation having seal interests will be content with less than the United States secured, nor is it likely they will obtain more, and thus they represent the measure of protection all seals are likely to receive in the future.

After reviewing an enormous mass of testimony, some good, some bad, and some very indifferent, concerning seal life, the Tribunal proposed to preserve the Alaskan branch of the northern fur seal, by prohibiting sealing within a zone of 60 miles around the Pribylof islands; by establishing a closed time, or time of no killing at sea, from May 1st to July 31st; by permitting only sailing vessels to engage in the business of seal-hunting, and requiring them to carry a distinctive flag, to take out special license, and to keep a daily record of the catch and the sex of the seals taken—these records to be communicated to each of the two Governments at the close of the sealing season; and by limiting the weapons of capture to shot guns in the North Pacific, and spears in Bering Sea. These regulations, which are to remain in force until they have

been wholly or in part abolished or modified by common agreement between the Government of the United States and Great Britain, are to be submitted every five years to a new examination, so as to enable both Governments to consider whether in the light of past experience there is occasion for any modification of them.

The three prime points in the regulations are, the zone around the islands, the closed time of three months injected into the middle of the sealing season, thus breaking it up, and the restrictions of the use of fire-arms to the North Pacific.

First, as to the zone: If there was any one fact clearly established by the testimony of the pelagic sealers and official experts, it was that in the summer season great numbers of seals, and especially females, are found at long distances from the islands of Bering Sea—distances at least three times greater than provided for in the regulations. Now, as the object was to preserve the fur seals, it is proper to assume that the Tribunal, prompted by a desire to protect them, and acting in good faith, established such a zone as they believed would practically prohibit the attack of the pelagic sealer, but if this were so, then mere amount of distance was immaterial, in view of the incessant fogs of Bering Sea, which render it difficult to tell when a vessel is within or without a zone the limits of which cannot be marked. Why not at once adopt that natural and well-defined boundary line, the Aleutian chain? Just here arises the question: When vessels are seized, whose word shall be accepted as to the locality of the seizure, the pelagic sealer's or the seizing officer's?

Does not this very uncertainty, affecting as it does the conviction of an offender, tend to encourage pelagic sealing? It would seem as though there were danger that these measures designed for settling disputes would promote endless contention, discord and bitterness in the future.

The adoption of a closed time of three months meant the recognition on the part of the Tribunal that the destruction by the pelagic sealer had been excessive, and the cutting off of one month of the sealing season in Bering Sea clearly showed that it realized how great was the danger to the herd from sealing there. Why, then, was sealing not prohibited altogether in those waters? Is the danger less in August or a portion of September? We have seen that the seals are still going long distances from the islands, and the sealer can continue his work until stopped by the September gales. Bering Sea is the focal point, the great massing ground of seal life, and the seals are more readily taken there than anywhere else. In 1891 the catch of the Canadian fleet in the North Pacific was a little over 21,000 seals, and before the *modus vivendi* could be enforced a portion of the fleet sealed from three to five weeks in Bering Sea, and with fewer vessels, and with fewer small boats they took over 28,000 seals during their short stay, as many if not more than were taken in the North Pacific during the entire season. During the three years ending with, and including 1891, the Canadian fleet took in five months in the North Pacific, an average of 567 skins per vessel; with ten vessels less, they took in Bering Sea 727 skins per vessel in about two and one-half months, or one-half the time.

The proposed regulations still allow at least five weeks' sealing in Bering Sea in a zone 60 miles off-shore. But, say the regulations, the hunters can only use spears in Bering Sea, thereby intimating that spears are less effective than the shot gun allowed in the North Pacific, and that an additional safeguard has therefore been provided in Bering Sea. Just why the shot gun is pernicious in Bering Sea, and is not in the North Pacific, is not indicated, but if we turn to the testimony of the Northwest Coast Indians, who ship on the schooners and accompany them to Bering Sea, we find that they claim that they can do better work with the spear than with the shot gun. The latter makes the game wild, while the former does not. The spear makes no noise, and they are able to take seal after seal as they sleep on the water and thus get all in sight, while at the sound of a gun's discharge, the comrades of the captured or wounded seal swim away.

In viewing these regulations as a whole, it is impossible to escape the impression which they give, that the Tribunal attempted to devise a scheme of protection which would be acceptable to both nations—a diplomatic course, but one rather difficult to follow. It seems to have been convinced as to the evils of pelagic sealing, but instead of squarely adopting prohibitive measures the Tribunal preferred to take a middle course, which, while appearing to concede something to the pelagic sealer, made the conditions just sufficiently hard to prevent him from engaging in the enterprise. It is admitted that these regulations possess value in limiting and discouraging pelagic sealing, but their inherent weakness is, that while they now seem

to possess a deterring power, changed conditions may at any time arise which will offer inducements sufficient to enable the sealers to continue in this business on a scale sufficiently large to destroy the herd. This contingency is not so remote as may appear at first sight. In 1889 the average price paid in Victoria for skins taken at sea was $6.83; in 1890 it had risen to $10.70; in 1891 it was $15.00. In 1889 the cost of each skin in wages was two to three dollars; in 1890 and 1891 it was $3.50, and in 1892 it was four dollars. In other words, an advancing price for both master and hunter. Now it is evident that it will be some time before the Pribylof Islands can very greatly increase their annual output of skins. The maximum output of the Commander Islands has been reached, and may have to be lessened in the future. It is hoped that through these regulations there will be some curtailment of the contributions of the sealing schooners, and this all means that seal skins will command a higher price. Should that price reach a figure which will compensate for the obstacles which the regulations place in the way of the pelagic sealer, then we will have the changed conditions referred to, and pelagic sealing, with its attendant evils, will go on as before. If there is doubt in the mind of any one upon this point, it is only necessary to turn to the history of the sea otter. This animal, though nearly exterminated, is as eagerly hunted to-day as it ever was, simply because the ever-increasing price the trade is willing to pay for its skin still compensates for the greater labor of its capture.

Another possible source of changed conditions lies in the regulations themselves, for they provide, as we

have seen, for their own modification every five years, and the pressure will come heaviest from the pelagic sealers' side of the case. Indeed, the regulations require that each pelagic sealer—an interested party—shall keep records, which are to be made available when the question of modification of the regulations arises. Now, while there was never a more fearless and courageous set of men than these pelagic sealers, it will be something entirely new in their history if their records do not appeal in the strongest possible terms for a modification of the regulations in their favor. If those records do not demonstrate beyond a doubt that the unlimited expansion of the seal herd can only be brought about by increased pelagic hunting, then indeed the pelagic sealer has reached a stage of mental deterioration.

It is evident from the history of the case that England will champion no plan of greater protection, nor is it expected that she would, but it is hard to realize that she would have been willing to lay herself liable to the charge of intentional dilatoriness. Doubtless it would be grateful to England and Canada to exchange sealing in the North Pacific Ocean for sealing in Bering Sea, or, for an unbroken period of sealing in the former to abandon sealing in the latter, or, as they vigorously urged before the Tribunal, to have the carrying out of these regulations dependent upon the United States' management of the Pribylof Islands. The United States would be glad to have some changes made also, but both nations agreed to abide by the decision of the Tribunal, and opportunities for such demands ceased when the decision was announced. There is only one

course which should now be pursued—abide by that decision.

There is but little credit to a nation which conforms to the findings of an arbitration only by being dragged up to the scratch at the last moment. The United States should permit no modifications of the regulations, save in the direction of greater stringency. It should, as it will continue to, stand squarely for the prompt and faithful execution of the Tribunal's verdict, letting time reveal how much value it possesses for protecting the seal herd. There are so many factors involved that actual experience alone can demonstrate its merits or demerits, but good or bad, let the regulations be put in force.

In conclusion let me say that, after more than two years' close study of this question, it is my conviction that the only way in which the world can secure the largest benefit commercially from the fur seal is by taking the surplus immature males upon land under the conditions suggested by past experience; that taking of seals by any other method introduces the fatal element of indiscrimination; that the life of the herd is jeopardized in proportion to the number of females killed; that the injury inflicted by pelagic sealing steadily increases from January to August, grows greater as Bering Sea is approached, and reaches its maximum in those waters; that the shot gun and spear are both deadly—the latter by reason of its noiseless efficiency, the former by reason of its ready use by all classes, and that the disposing of this question on the basis of adjusting two conflicting interests is futile and illogical. Material issues are not alone involved. It is a question

which presents as well biologic features that refuse to be disposed of by archaic human laws, and it has to do with forces of Nature beyond man's control. Regulations cannot be framed by human ingenuity which will preserve the seal herd in their greatest possible magnitude and permit the continuation of pelagic sealing. It would be reconciling the irreconcilable. It would be accomplishing a feat equal to that of making two bodies occupy the same space at the same time. Either the regulations will be prohibitive in their operation, in which case it would be more straightforward to make them so in the first instance, or if allowing successful pelagic sealing they will be valueless in preventing the extermination of the seals. No pelagic sealing can be carried on which is not in proportion to its magnitude a menace to the life of the herd.

GEOGRAPHICAL NOTES,

BY

GEO. C. HURLBUT, *Librarian.*

THE BRITISH ASSOCIATION.—The meeting of the British Association for the Advancement of Science was opened in the Sheldonian Theatre, Oxford, on the 8th of August, with an address by Lord Salisbury, who, as Chancellor of the University of Oxford, tendered the welcome which it was his duty, as President of the British Association, to accept.

In his address, which was equally solid and brilliant, he called attention to some of the problems that still defy investigation—the enigma of the elements, the inscrutability of the ether, the central mystery of life, evolution, and the hypothesis of natural selection—and he quoted, as his own concluding words, the language with which Lord Kelvin* closed his presidential address more than twenty years ago:

> I have always felt that the hypothesis of natural selection does not contain the true theory of evolution, if evolution there has been in biology. * * * I feel profoundly convinced that the argument of design has been greatly too much lost sight of in recent zoological speculations. Overpoweringly strong proofs of intelligent and benevolent design lie around us, and if ever perplexities, whether metaphysical or scientific, turn us away from them for a time, they come back upon us with irresistible force, showing to us through nature the influence of a free will, and teaching us that all living things depend on one everlasting Creator and Ruler."

Captain W. J. L. Wharton, R. N., F. R. S., President

* Better known as Sir William Thomson.

of the Section of Geography, delivered the following address*:

You will not be surprised if, having called upon an hydrographer to preside over this Section, he takes for the subject of his review the Sea. Less apparently interesting, by reason of the uniformity of its surface, than the land which raises itself above the level of the waters, and with which the term geography is more generally associated, the ocean has, nevertheless, received much attention of later years. In Great Britain, especially, which has so long rested its position among the nations upon the wealth which our merchant fleets bring to its shores, and upon the facilities which the sea affords for communication with our numerous possessions all over the globe, investigation into the mysteries, whether of its ever moving surface or of its more hidden depths, has been particularly fascinating. I purpose, therefore, to attempt a brief survey of our present knowledge of its physical condition.

The very bulk of the ocean, as compared with that of the visible land, gives it an importance which is possessed by no other feature on the surface of our planet. Mr. John Murray, after a laborious computation, has shown that its cubical extent is probably about fourteen times that of the dry land. This statement appeals strongly to the imagination, and forms, perhaps, the most powerful argument in favor of the view, steadily gaining ground, that the great oceans have in the main existed in the form in which we now see them since the constituents of the earth settled down into their present condition.

When it is considered that the whole of the dry land would only fill up one-third of the Atlantic Ocean, the enormous disproportion of the two great divisions of land and sea becomes very apparent.

The most obvious phenomenon of the ocean is the constant horizontal movement of its surface waters, which in many parts take well-defined directions. These great ocean currents have now been studied for many years, and our knowledge of them is approaching a point beyond which it is doubtful whether we shall ever much advance, except in small details. For though, while indisputably the waters continually move in each great area in generally the same direction, the velocities vary, the limits of the different streams and drifts vary, mainly from the ever-varying force and direction of the winds.

After long hesitation and much argument, I think it may be now safely held that the prime motor of the surface currents is the wind. Not, by any means, the wind that may blow, and even persistently blow, over the portion of water that is moving, more or less rapidly, in any direction, but the great winds which blow generally from the same general quarter over vast areas. These, combined with deflection from the land, settle the main surface circulation.

I do not know if any of my hearers may have seen a very remarkable model, devised by Mr. Clayden, in which water disposed over an area shaped like the

* Reprinted from *Nature*, of August 16.

Atlantic, and sprinkled over with lycopodium dust to make movement apparent, was subjected to air impelled from various nozzles, representing the mean directions of the permanent winds. It dispelled the last doubt I held on the subject, as not only were the main currents reproduced, but the smaller effects and peculiarities of the Atlantic drifts were produced with surprising accuracy.

There is a small current, long shown on our charts, but which I had always regarded with suspicion. I refer to the stream which, after travelling from the Arctic Ocean southward along the east coast of Greenland, turns sharply round Cape Farewell to the northward into Davis Straits, where it again doubles sharply on itself to the southward. This is exhibited, in the model, in all its details, and is evidently caused by the pressure of the water forced by the mimic Gulf Stream into the Arctic region, where it has no escape except by this route, and is pressed against the land, round which it turns as soon as it can. This is, no doubt, the explanation of the real current.

The very remarkable winter equatorial current, which runs in a narrow belt eastwards, just north of the main stream travelling west, was also reproduced with extraordinary fidelity.

The winds, however, that are ordinarily considered permanent vary greatly, while in the monsoon areas the reversal of the currents caused by the opposite winds exercises a great influence on the movements of the water far beyond their own limits, and anything like a prediction of the precise direction and rate of an oceanic stream can never be expected.

The main facts, however, of the great currents can be most certainly and simply explained in this manner.

The trade winds are the prime motors. They cause a surface drift of no great velocity over large areas in the same general direction as that in which they blow. These drifts after meeting and combining their forces eventually impinge on the land.

They are diverted and concentrated and increase in speed. They either pour through passages between islands, as into the Caribbean Sea, are pressed up by the land, and escape by the only outlets possible—as, for example, the Strait of Florida, and form a great ocean current like the Gulf Stream—or, as in the case of the Agulhas current and the powerful stream which runs north along the Zanzibar coast, they are simply pressed up against and diverted by the land, and run along it with increased rapidity.

These rapid currents are eventually apparently lost in the oceans, but they in their turn originate movements of a slower character, which on again passing over shallow water or on meeting land develop once more into well defined currents.

We find an analogous state of things on the western side of the Pacific, where the Japan current is produced in a similar manner.

The fact that on all western shores of the great oceans towards which the trade winds blow we find the strongest currents running along the coast, is almost enough of itself to prove the connection between them.

The westerly winds that prevail in higher northern and southern latitudes are

next in order in producing great currents. From the shape of the land they in some cases take up and continue the circulation commenced by the trade winds; in others they themselves originate great movements of the water.

Compared to the great circulation from this source, the effect of differences of temperature or of specific gravity is insignificant, though no doubt they play their part, especially in causing slow under-circulation, and in a greater degree the vertical mixing of the lower waters.

No drop of the ocean, even at its greatest depth, is ever for one moment at rest.

Dealing with minor points, the American officers of the Coast and Geodetic Survey have found after long and patient investigation that the velocity of the Gulf Stream in its initial and most marked part, the Strait of Florida, is greatly affected by the tide, varying as much as one-half its maximum rate during the twenty-four hours.

These American investigations are of greatest interest. They have extended over the whole area of the Caribbean Sea and its approaches, the Gulf of Mexico, and the Gulf Stream proper and its vicinity. In no other part of the ocean has observation of this detailed character been carried out, and they throw a great light on oceanic circulation. The *Blake*, the vessel specially fitted for the purpose, has during the several years in which she was employed on this work anchored in over 2000 fathoms of water, or a depth of considerably more than two miles; a feat which would a short time ago have been deemed impossible.

One great point that has come out very strongly is the continual variation in the strength and direction of the currents, and the varying depths to which the surface current extends.

Eastward of the chain of the Windward Islands the general depth of the surface movement may be said to be about 100 fathoms, below which tidal influence is very distinct.

There is also a very plain backward flow of water, at depths which vary, caused by the submarine ridge which connects the Windward Chain of the West Indian Islands. These observations also generally support what I have already mentioned: that the velocity of a current depends on the strength of winds, possibly thousands of miles distant, which have given the original impetus to the water, and this, combined with tidal action when the current approaches or runs along a coast, will always cause uncertainty on the resultant velocity.

Dealing for yet another moment with the Gulf Stream, there are two points which have not been much dwelt upon, but which have a great effect on its power of bringing the modifying influence of its warm water as far as our shores.

The first is the prevention of its spreading, as it leaves the Strait of Florida, by the pressure of the portion of the equatorial current which, unable to get through the passages between the Windward Islands, is diverted to the north of the Bahamas, and bears down on the eastward side of the Gulf Stream proper, compressing it between itself and the cold water flowing southward along the American coast, and at the same time adding to its forces and maintaining its high temperature.

The second is that by the time the Gulf Stream has lost its velocity as a current in about the vicinity of the Banks of Newfoundland, it has arrived in the region of the westerly winds, that is, of winds whose average direction is from west; whose influence, causing a surface drift somewhat comparable to that of the trade winds, bears the water onward to the British Islands and Norway. Without these prevailing westerly winds the warm water of the Gulf Stream would never reach these shores.

The depth to which the surface currents extend in other parts is little known. Direct observations on under-currents have been rare.

In the first place, it is not an easy observation to make. Apparatus has generally to be improvised. This has usually consisted of some form of flat surface lowered to the required depth, and suspended in the water by a buoy, which presents to the resistance of the upper stratum a very much smaller area than that of the surface below.

More perfect machines have been devised, notably that used by the Americans in their West Indian experiments.

These, however, are delicate, and require so much care and experience in working, and so much time is wanted for such observations, that under the pressure of the more urgent requirements on surface movements in the interests of navigation very little has been done.

The *Challenger* made some observations on the depth of the equatorial current in mid-Atlantic, but they were not very conclusive for lack of suitable appliances. They, however, tended to show that below 100 fathoms there was but little current.

It has been calculated theoretically that winds blowing steadily in one direction with the ordinary force of the trade winds would, in 100,000 years, by friction between the particles, put the whole of a mass of water 2,000 fathoms deep, not otherwise influenced, into motion in that direction; but the direction and force of the trade winds are ever changing, and the actual strong currents of the ocean are not in the trade wind areas, but are the result of these drifts meeting one another and being compressed by the conformation of the land. We cannot, therefore, expect this theoretical effect to be realized.

One instance of the underrunning of one current by another is brought very plainly to our notice in the North Atlantic, to the east of the Great Banks of Newfoundland, where the icebergs borne by the Arctic current from Baffin Bay pursue their course to the southward across the Gulf Stream running eastward.

These great masses of ice, floating with seven-eighths of their volume under the surface, draw so much water that they are all but wholly influenced by the under-current. A large berg will have its bottom as much as six or seven hundred feet below the surface. The only reason that these bergs continue their journey southward is the action of the cold under-current.

It was my good fortune to be ordered in 1872 to undertake a series of experiments of the currents and under-currents of the Dardanelles and Bosporus. They proved most interesting.

It was well known that a surface stream is almost continuously passing out of the Black Sea through the Bosporus into the Sea of Marmara, and again through

the Dardanelles into the Mediterranean. Certain physicists, of whom Dr. W. Carpenter was one, were, however, of opinion that a return current would be found under the surface running in the opposite direction, and this I was enabled to demonstrate.

Though from the imperfection of our apparatus, which we had to devise on the spot, we were unable to exactly proportionate the quantities of water moving in the two directions, we found, whenever the surface current was rushing south-westward through these straits, that for a certain distance, from the bottom upwards, the water was in rapid motion in the opposite direction. It was an astonishing sight to behold the buoys which supported a wooden framework of 36 square feet area, lowered to depths from 100 to 240 feet, tearing up the straits against a strong surface current of as much as three and four miles an hour. It was as perfect an ocular demonstration of a counter under-current as could be wished, and the Turks, who watched our proceedings with much suspicion, were strongly of opinion that the devil had a hand in it, and only the exhibition of the Sultan's firman saved us from interruption. In the investigation of these currents we found, as usual, that the wind was the most potent agent. Though the surface water from the Black Sea is almost fresh, and the bottom water of the heavy Mediterranean density of 1.027, it was found that when calm had prevailed the surface current slackened, and at times became nil, whilst the under-current responded by a similar slackening.

The ordinary condition of wind in the regions of the Black Sea and Sea of Marmara is that of a prevalent north-east wind. This causes a heaping up of the water on the south-west shores of those seas, precisely where the straits open, and the surface water, therefore, rapidly escapes.

These straits, no doubt, present abnormal characters, but, so far as surface currents are concerned, the long series of observations then made convinced me of the inadequacy of differences of specific gravity, which were here at a maximum, to cause any perceptible horizontal flow of water.

I have said that we were unable to define by direct observation the exact position of the dividing line between the opposing currents, but the rapid change in the specific gravity at a certain depth, which varied on different days, gave a strong indication that the currents changed at this point.

A Russian officer, Captain Makaroff, afterwards made similar experiments in the Bosporus, but with more perfect appliances, and he found that at the point where the specific gravity changed the currents also changed.

I have been anxious to obtain similar observations at the Straits of Bab-el Mandeb, the southern outlet of the Red Sea, where somewhat similar conditions prevail. Here the winds are governed by the monsoons. For half the year the wind blows from the north down the whole length of the sea, causing a surface flow outwards into the Gulf of Aden, and a general lowering of the whole level of the sea of about two feet. For the other half of the year the wind at the southern end of the sea is strong from the south-east, causing a surface set into the Red Sea, over which the general level of the water rises, while the northerly wind continues to blow throughout the northern half.

At either of these times I think it is highly probable that there is an under-current in the opposite direction to that at the surface, but unfortunately the sea disturbance is great and observations are very difficult.

Observations were, however, made by Captain W. U. Moore in H.M.S. *Penguin* in 1890, but at a time when the change of monsoon was taking place.

The result was peculiar, for it appeared that at a depth of about 360 feet the movement of the water was tidal, while the surface water was moving slowly in one direction—a result generally similar to that obtained by the Americans in the West Indies—but the direction of the tidal flow was directly opposite to what might have been expected, viz., the water ran in while the tide fell, and *vice versa*.

More observations are, however, needed here before any certain conclusions can be formed.

The depth of the ocean is the next great feature which demands attention.

On this our knowledge is steadily, though slowly, increasing.

The whole of it has been gained during the last fifty years.

Commenced by Sir James Ross, whose means were very small, but who nevertheless demonstrated that the so-called unfathomable ocean was certainly fathomable everywhere, the sounding of the ocean has continuously proceeded. The needs of submarine cables have constantly demanded knowledge in this particular, and the different cable companies have had a large share in ascertaining the facts.

Expeditions, whose main object has been to obtain soundings, have been sent out, Great Britain and the United States taking the first place; but most maritime nations have aided.

In the immediate past the additions have mainly been from the soundings which H. M. surveying ships continually take whenever on passage from one place to another, from the work of our cable companies, and from United States vessels.

We have, as a result, a very fair general knowledge of the prevailing depths in the Atlantic, but of the Indian and Pacific Oceans it is very fragmentary. We have enough to give us a general idea, but our requirements increase as years roll on. It is a vast task, and, it may be safely said, will never be completed; for we shall never be satisfied until we know the variations of level under the water as well as we know those on the dry land.

It is hopeless to do more than to briefly sketch the amount of our knowledge.

First, as to the greatest depths known. It is very remarkable, and from a geological point of view significant, that the very deepest parts of the ocean are not in or near their centres, but in all cases are very near land.

One hundred and ten miles outside the Kurile Islands, which stretch from the northern point of Japan to the north-east, the deepest sounding has been obtained of 4,655 fathoms, or 27,930 feet. This appears to be in a deep depression, which runs parallel to the Kurile Islands and Japan; but its extent is unknown, and may be very large.

Seventy miles north of Porto Rico, in the West Indies, is the next deepest cast known, viz., 4,561 fathoms, or 27,366 feet; not far inferior to the Pacific depth, but here the deep area must be comparatively small, as shallower soundings have been made at distances sixty miles north and east of it.

A similar depression has been sounded during the last few years west of the great range of the Andes, at a distance of fifty miles from the coast of Peru, where the greatest depth is 4,175 fathoms.

Other isolated depths of over 4,000 fathoms have been sounded in the Pacific. One between the Tonga or Friendly Islands of 4,500 fathoms, one of 4,478 fathoms near the Ladrones, and another of 4,428 fathoms near Pylstaart Island, all in the Western Pacific. They all require further investigation to determine their extent.

With these few exceptions, the depth of the oceans, so far as yet known, nowhere comes up to 4,000 fathoms, or four sea miles; but there can be little doubt that other similar hollows are yet to be found.

The sea with the greatest mean depth appears to be the vast Pacific, which covers 67 millions of the 188 millions of square miles composing the earth's surface.

Of these 188 millions, 137 millions are sea, so that the Pacific comprises just one-half of the water of the globe, and more than one-third of its whole area.

The Northern Pacific has been estimated by Mr. John Murray to have a mean depth of over 2,500 fathoms, while the Southern Pacific is credited with a little under 2,400 fathoms. These figures are based on a number of soundings which cannot be designated otherwise than very sparse.

To give an idea of what remains to be done, I will mention that in the eastern part of the Central Pacific, there is an area of 10,500,000 square miles in which there are only seven soundings, whilst in a long strip crossing the whole North Pacific, which has an area of 2,800,000 square miles, there is no sounding at all. Nevertheless, while the approximate mean depth I am mentioning may be considerably altered as knowledge increases, we know enough to say that the Pacific is generally deeper than the other oceans. The immensity, both in bulk and area, of this great mass of water, is difficult to realise; but it may assist us when we realise that the whole of the land on the globe above water level, if shovelled into the Pacific, would only fill one-seventh of it.

The Indian Ocean, with an area of 25,000,000 square miles, has a mean depth, according to Mr. Murray, of a little over 2,000 fathoms. This also is estimated from a very insufficient number of soundings.

The Atlantic, by far the best sounded ocean, has an area of 31,000,000 square miles, with a mean depth of about 2,200 fathoms.

The temperature of this huge mass of water is an interesting point.

The temperature of the surface is most important to us, as it is largely on it that the climates of the different parts of the world depend. This is comparatively easy to ascertain. We know so much about it that we are not likely to improve on it for many years. We are quite able to understand why countries in the same latitude differ so widely in their respective mean temperatures; why fogs prevail in certain localities more than others; and how it comes about that others are subject to tempestuous storms.

On the latter point nothing has come out plainer from recent discussion than the fact that areas where great differences of surface temperature of the sea prevail are those in which storms are generated.

It is a matter of observation that in the region south of Nova Scotia and Newfoundland, many of the storms which travel over the Atlantic to this country have their rise.

An examination of surface temperature shows that in this region the variations are excessive, not only from the juxtaposition of the warm water of the Gulf Stream and the cold water of the Arctic current flowing southward inside of it, but in the Gulf Stream itself, which is composed of streaks of warm and colder water, between which differences of as much as 20° F. exist.

The same conditions exist south of the Cape of Good Hope, another well-known birthplace of storms. Here the Agulhas current of about 70° F. diverted by the land pours into the mass of water to the southward, colder by some 25°, and the meeting-place is well known as most tempestuous.

South-east of the Rio de la Plata is another stormy area, and here we find the same abnormal variations in surface temperature.

Yet another is found off the north-east coast of Japan with the same conditions.

These differences are brought about by the mingling of water carried either by the flowing of a powerful current turned by the land into a mass of water of different temperature, as is the case off the Cape of Good Hope, or by the uprising of lower strata of cooler water through a shallow surface stream, as appears to be the case in the Gulf Stream.

A remarkable point recently brought to light by the researches of Mr. John Murray in Scotch lochs is the effect of wind on the surface temperature. It has been observed that wind driving off a shore drifts the surface water before it. This water is replaced by the readiest means, that is to say, by water from below the surface rising to take its place. As the lower strata are in all cases cooler than the surface, a lowering of the temperature results, and we find, in fact, that near all sea shores off which a steady wind blows the water is cooler than further to seaward.

This has an important bearing on coral growth, and explains why on all western coasts of the great continents off which the trade winds blow we find an almost absolute dearth of coral, while on the eastern coasts, on which warm currents impinge, reefs abound, the coral animal flourishing only in water above a certain temperature.

Observations of the temperature of the strata of water between the surface and bottom have been of late years obtained in many parts. Compared with the area of the oceans they are but few, but our knowledge steadily increases every year.

The subject of the vertical distribution of temperature has not yet been thoroughly investigated in the light of the whole of the information which we now possess, but Dr. Alex. Buchan has been for some time devoting his spare time to the task, and it is a heavy labour, for the data obtained here and there over the world by different ships of all maritime nations are very difficult to collect and to appraise, but I understand that before long we shall have the result, which will prove very interesting, in the last volume of the *Challenger* series.

It will readily be understood that observations on temperatures at great depths require great care. In the first place, the thermometers must be most carefully

manufactured. They must be subjected to rigorous tests, and they must be carefully handled during the operation. All observations are not of the same value, and the discussion, therefore, presents considerable difficulty and demands much discretion.

In the meantime we can state certain known facts.

We have learnt that the depth of the warm surface water is small.

In the equatorial current between Africa and South America, where the surface is of a temperature of 78°, at 100 fathoms it is only 55°, a difference of 23°, and a temperature of 40° is reached at 400 fathoms. In this region, so far as knowledge goes, the fall in temperature as we descend is most rapid, but generally speaking the same variations prevail everywhere.

In the tropical Pacific the temperature falls 32° from the surface, where it stands at 82°, to a depth of 200 fathoms, 40° being reached at from 500 to 600 fathoms below the surface.

Below the general depth of from 400 to 600 fathoms, the temperature decreases very slowly, but there is considerable variation in the absolute amount of it when we get to great depths in different parts of the ocean.

One of the most interesting facts that have been recognised is, that in enclosed hollows of the ocean the bottom temperature is apparently much less than that of the stratum of water at a corresponding depth in the waters outside the submarine ridge that forms the enclosing walls, separating them from deeper areas beyond, and is, in all cases that have been observed, equal to that on the ridge. From this fact we are enabled to supplement our imperfect knowledge of depths, because if in a certain part of an ocean we find that the temperature at great depths is higher than we know exists at similar depths in waters apparently connected, we can feel certain that there is a submarine ridge which cuts off the bottom waters from moving along, and that the depth on this ridge is that at which is found the corresponding temperature in the outer waters. As a corollary we also assume that the movement of water at great depths is confined to an almost imperceptible movement, for if there was a motion that we could term, in the ordinary acceptation of the word, a current, it would infallibly surmount a ridge and pour over the other side, carrying its lower temperature with it.

A notable instance is the bottom temperature of the North Atlantic. This is nowhere below 35° F., although the depths are very great. But in the South Atlantic at a depth of only 2,800 fathoms the bottom temperature is but a little above 32° F., and we are therefore convinced that somewhere between Africa and South America, though soundings do not yet show it, there must be a ridge at a depth of about 2,000 fathoms.

We also come to the same conclusion with regard to the eastern and western portions of the South Atlantic, where similar differences prevail.

Again, the few temperatures that have been obtained in the eastern South Pacific show a considerable difference from those in the South Atlantic, and we are compelled to assume a ridge from the Falkland Islands to the Antarctic continent.

It is interesting that the investigation into the translation of the great seismic

wave caused by the eruption of Krakatoa in 1883, led to a similar and entirely independent conclusion. The wave caused by the explosion in the Straits of Sunda reached Cape Horn, where by good chance a French meteorological expedition had erected an automatic tide gauge, but instead of one series of waves being marked on the paper there were two. A little consideration showed that the South Pole having directly interposed between Sunda Straits and Cape Horn, the waves diverted by the land about the pole would arrive from both sides.

One wave, however, made its appearance seven hours before the other.

Study showed that the earlier wave coincided in time with a wave travelling on the Pacific side of the pole, with a velocity due to the known depth, while the later wave must have been retarded in its journey *via* the South Atlantic. The only possible explanation is that the wave had been impeded by comparatively shallow water.

The evidence from bottom temperature was then unknown, and thus does one branch of investigation aid another.

In the Western Pacific the water is colder, a few bottom temperatures of a little over 33° F. having been found in the deep trough east of the Tonga Islands; but the North Pacific, though the deeper ocean—of enormous area and volume—is apparently again cut off by a submarine ridge. The north-western part of the Indian Ocean is for similar reasons assumed to be divided from the main body, the shallower water probably running from the Seychelles to the Maldive Islands.

Mr. Buchanan has pointed out why some parts of oceans, deep and vast though they be, are when cut off from communication with others warmer at the bottom.

Water can only sink through lower layers when it is the heavier, and though a warm surface current becomes from evaporation denser, its heat makes it specifically lighter than the strata below.

It is only when such a current parts gradually with its heat, as in travelling from tropical to temperate regions, that it sinks and slowly but surely carries its temperature with it, modifying the extreme natural cold of the bottom layers.

In the North Atlantic and Pacific we have such a condition. The great currents of the Gulf Stream and Japan current as they flow to the north sink, and in the course of ages have succeeded in raising the bottom temperature three or four degrees.

In the southern seas this influence is not at work, and, directly connected with the more open water round the South Pole, there is nothing to carry to the abysmal depths any heat to raise them from their normal low temperatures, due to the absence of any heating influence.

The ice masses round the South Pole have probably little or no effect on bottom temperature, as the fresher, though colder, water will not sink; and, as a matter of fact, warmer water is found at a few hundred fathoms than at the surface.

The lowest temperature ever obtained was by Sir John Ross in the Arctic Ocean in Davis Straits at a depth of 680 fathoms, when he recorded a reading of 25°F. This probably requires confirmation, as thermometers of those days were somewhat imperfect.

In the great oceans the greatest cold is found on the western side of the South Atlantic, where the thermometer stands at 32°.3 F., but temperatures of 29° F. have been obtained of recent years east of the Færoe Islands, north of the ridge which cuts off the deeper waters of the Arctic from the Atlantic.

Though scarcely within the limits of my subject, which is the sea itself, I must say a few words on the sea floor.

The researches carried on in the *Challenger* revealed that while for a certain distance from the continents the bottom is composed of terrestrial detritus, everywhere in deep water it is mainly composed of the skeletons or remains of skeletons of the minute animals that have lived in the water.

In comparatively small depths we find remains of many shells. As the depth increases to 500 fathoms or so we get mainly the calcareous shells of the globigerinæ, which may be said to form by far the greater part of the oceanic floor.

In deeper water still, where pressure, combined with the action of the carbonic acid, has dissolved all calcareous matter, we find an impalpable mud with skeletons of the silicious radiolaria of countless forms of the greatest beauty and complexity. Deeper still, *i. e.*, in water of—speaking generally—over 3,000 fathoms, we find a reddish colored clayey mud, in which the only traces of recognisable organic remains are teeth of sharks and cetacea, many belonging to extinct species.

What the depths of these deposits may be is a subject of speculation. It may be that some day, as mechanical appliances are improved, we shall find means of boring, but up to the present no such operation has been attempted.

On the specific gravity of the water of the sea I can say but little except that it varies considerably.

It is not yet known for certainty how far the specific gravities observed at various points and depths remain appreciably constant.

In localities where evaporation is great, and other influences do not interfere, it is evident that the specific gravity of the surface will be high; a consideration which observations confirm, but there are many complications which require more observation before they can be resolved.

In some few places repeated observations permit deductions, but taking the sea as a whole we are yet very ignorant of the facts bearing on this point.

The waves which forever disturb the surface of the sea demand much study.

The greatest of these, and the most regular, is the tidal wave. On this many powerful intellects have been brought to bear, but it still presents many unsolved anomalies.

Lord Kelvin and Prof. Darwin have demonstrated that the tidal movement is made up of many waves depending upon different functions of the moon and sun, some being semidiurnal, some diurnal. The time of transit over the meridian, the declination of both bodies, create great variations; the changing distance and position of the moon and the position of her node, also have great effect, while the ever-varying direction and force of the winds, and the different pressure of the atmosphere play their part, and sometimes a very large part, on what is somewhat loosely known as the meteorological tide.

The amplitude of the oscillation of the water depending upon each of the astronomical functions varying for every point on the earth, the effect is that, each having a different period, the resulting mean movement of the water has most astonishing variations.

In some places there is but one apparent tide in the day; in others this phenomenon only occurs at particular periods of each lunation, while in the majority of cases it is the movements of each alternate tide only that appear to have much to do with one another.

Though after long observation made of the times and ranges of tides at any one spot, they can now be predicted with great accuracy for that particular place, the meteorological tide excepted, by the method of harmonic analysis, perfected by Prof. G. Darwin, no one yet can say what the tide will be at any spot where observations have not been made.

Observations all over the world have now shown that there is no part where the tidal movement is so regular and simple as around the British Islands. This is more remarkable when it is found that the tides on the other side of the Atlantic —at Nova Scotia, for instance—are very complicated.

The minor tides, which, in most parts of the world, when combined in one direction, amount to a very considerable fraction of the principal lunar and solar tides, and consequently greatly increase or diminish their effects, are in Great Britain so insignificant that their influence is trifling; but why this should be, I have never yet found any one to explain.

Nevertheless, there are many very curious points about our tides which are plainly caused by interference, or, in other words, by the meeting of two tidal waves arriving from opposite directions, or from the rebound of the tidal waves from other coasts.

This effect, also, it has been so far found impossible to predict without observation. On our southern coasts, for instance; in the western part the tide rises about 15 feet, but as it travels eastward the range becomes less and less, until, about Poole, it reaches a minimum of 6 feet. Farther east again it increases to Hastings, where the range is 24 feet. Yet farther east it again gradually diminishes. This is due to the reflection from the French coast, which brings another wave which either superposes itself upon, or reduces the effect of, the main tide advancing up the English Channel; but the details of such reflection are so complex that no one could forecast them without more knowledge than we possess.

There can be little doubt that to this cause, reflection, are mainly due the variations in the amount of mean range of tide which are found on many coasts at different parts; and as these reflected waves may arrive from great distances, and be many in number, we may cease to wonder at the extraordinary differences in range of tide which prevail, though it will be understood that this is wholly separate from the varying heights of each successive tide, or of the tide at different parts of each lunation, or at different times of the year, which depend upon the astronomical influences.

The actual height of the tide in deep water is small, but on passing into shallow water when approaching a shore, and especially when rolling up a gulf of more

or less funnel shape, it becomes increased by the retardation caused by friction, and by compression laterally, and hence the height of the tide on a coast affected by other causes is greater than in the open sea.

The oceanic tide wave is supposed to be from 2 to 3 feet in height, but as this has been assumed from observations made at small oceanic islands, where, although the magnifying influences mentioned are at a minimum, they still exist, we wait for precise information until some means of actually measuring the tide in deep water is devised.

The waves due to wind, though not so far-reaching in their effects as the majestic march of the tide wave, are phenomena which are more apparent to the traveller on the ocean.

The deep sea in a heavy gale presents, perhaps, the most impressive manifestation of the powers of nature which man can behold, and doubtless many of us have experienced feelings that may vary from awe and wonder to sheer delight, according to the temperament of each individual, at for the first time finding himself face to face with this magnificent sight, though I rather fear that discomfort is the prevailing feeling that many carry away.

The height to which storm waves may rise has never been very satisfactorily determined. Apart from the difficulty of the task and the small number of people who will address themselves to it when they have the chance, it is but rarely that any individual sees really abnormal waves, even though he may be at sea all his life.

Different heights for what are called maximum waves have been recorded, and they vary from 40 to 90 feet from crest to hollow.

All we can say is that the most probable figure is about 50 or 60 feet.

These great storm waves travel very far. In some cases they convey a warning, as their velocity always far exceeds that at which the storm is travelling. In others they intimate that a gale of which no more is seen has occurred somewhere —it may be many miles distant.

When they have travelled beyond the limits of the wind which raised them, they lose the steepness of slope which characterizes them when under its influence, and become an undulation which is scarcely noticed when in deep water.

On approaching shallow water, however, they are again apparent, and the "rollers" that occur unperiodically at various places in latitudes where gales never occur would seem to be caused by such waves, originating in areas many thousands of miles distant. Such appears to be the origin of the well-known rollers at Ascension and St. Helena, where the rocky and exposed nature of the landing has caused this phenomenon to be especially noticed.

Other rollers are, however, undoubtedly due to earthquakes or volcanic eruptions occurring in the bed of the sea.

Many of the great and sudden waves which have caused devastation and great loss of life on the shores of western South America are referable to this cause.

Observations to enable the focus of such a disturbance to be traced have generally been lacking, but it is probable that where the wave has been large the point of origin has not been far distant.

In one notable instance the conditions were reversed. The point of origin was known, and the distance to which the resulting wave travelled could be fairly satisfactorily traced.

This was the great eruption in the Straits of Sunda, in August, 1883, which locally resulted in the disappearance of the major part of the island of Krakatoa, and the loss of nearly 40,000 lives, on the neighbouring shores of Java and Sumatra, by the huge wave which devastated them.

The records of automatic tide gauges and the observations of individuals enabled the waves emanating from this disturbance to be followed to great distances. These waves were of great length, the crests arriving at intervals of about an hour, and moving with a velocity of about 350 miles an hour, were about that distance apart.

The waves recorded at Cape Horn were apparently undoubtedly due to the eruption, and travelled distances of 7,500 miles and 7,800 miles in their course on either side of the south polar land.

They were only five inches in height above mean level of the sea, while the waves recorded at places on the southern part of Africa, at a distance of about 5,000 miles from the scene of the eruption, were from one to two feet high, the original long waves being of an unknown height, but probably did not exceed ten or fifteen feet.

No other such opportunity of testing the distances to which great waves may travel has ever occurred, and as such a catastrophe as gave rise to them could scarcely be repeated without similar loss of life, it may be hoped we shall not live to see another, interesting though the discussion of the numerous phenomena was.

The movement of the particles of water due to the tide wave extends to the bottom of the deepest water, and doubtless plays an important part in keeping up a constant motion in the abysses, but the depth to which the action of the surface waves originating in wind reaches is still but little known by observation.

If, however, we study the contour of the bottom off the shores of land exposed to the full influence of the great oceans, we are struck by the very general rapid increase of slope after a depth of about 80 to 100 fathoms (500 to 600 feet) has been reached.

It appears probable that this is connected with the depth to which wave action may extend, the fine particles brought down by rivers or washed from the land by the attrition of the breakers being distributed and gradually moved down the slope.

When we examine banks in the open sea we find, however, that there are a great many with a general depth of from 30 to 40 fathoms, and the question arises whether this may not be the general limit of the power of oceanic waves to cut down the mass acted upon when it is fairly friable.

The question has an interesting bearing on the subject of the ever-debated origin of coral atolls, for this is the general depth of many large lagoons; and, granted that the sea can cut down land to this depth, we have at once an approach to the solution of the problem of the formation of bases of a suitable depth and material upon which the coral animal can commence operations.

This question also awaits more light, and I merely offer this remark as a suggestion.

It is, however, somewhat remarkable that in recent cases of volcanic islands piled up by submarine eruptions, they have all been more or less rapidly washed away, and are in process of further diminution under the surface.

Observations on the mean level of the sea show that it constantly varies, in some places more than others. This subject has not yet been worked out.

In some localities it is plainly due to wind, as in the Red Sea, where the summer level is some two feet below that of winter, owing to the fact that in summer the wind blows down the whole length of the sea, and drives the water out.

In many places, as in the great estuary of the Rio de la Plata, the level is constantly varying with the direction of the winds, and the fluctuation due to this cause is greatly in excess of the tidal action.

In others the cause is not so clear.

At Sydney, New South Wales, Mr. Russell found that during eleven years the level was constantly falling at about an inch a year, but by the last accounts received it was again stationary.

The variations in the pressure of the atmosphere play an important part in changes of sea level.

A difference of one inch in the barometer has been shown to be followed by a difference of a foot in the mean level of the sea, and in parts of the world where the mean height of the barometer varies much with the seasons, and the tidal range is small, this effect is very marked.

Of any secular change in the level of the sea little is known. This can only be measured by comparison with the land, and it is a question which is the more unstable, the land or the water—probably the land, as it has been shown that the mass of the land is so trifling, compared with that of the ocean, that it would take a great deal to alter the general mean level of the latter.

All the points connected with the sea that I have had the honor of bringing before you form part of the daily observation of the marine surveyor when he has the chance, but I cannot refrain from also mentioning other duties, which are indeed in the present state of our knowledge and of the practical requirements of navigation the principal points to which he has to pay attention, as it may explain why our knowledge on so many interesting details still remains very imperfect.

Working as we do in the interests of the vast marine of Great Britain, the paramount necessity of good navigational charts requires that the production of such charts should be our principal aim.

It is difficult for a landsman and difficult even for a sailor who has never done such work to realize the time that is necessary to make a really complete marine survey. The most important part, the ascertainment of the depth, is done, so to speak, in the dark—that is to say, it is by touch and not by sight that we have to find the different elevations and depressions of the bottom of the sea.

In making a map of the land, an isolated rock or hill stands up like a beacon above the surrounding land, and is at once localised and marked, but a similar object under the sea can only be found by patient and long-continued sounding, and may very easily be missed.

When it is considered that marine surveying has only been seriously undertaken for about 100 years, with a very limited number of vessels, we shall, I think, understand how in the vast area of the waters, taking only those bordering the shores, many unsuspected dangers are yearly discovered.

Very, very few coasts have been minutely surveyed, and setting aside for a moment the great changes that take place off shores where sandbanks prevail, I should be sorry to say that even on our own coasts charts are perfect.

Yearly around Great Britain previously unknown rocks come to light, and if this is the case at home, what are we to think of the condition of charts of less known localities?

Our main efforts, therefore, are directed to the improvement of charts for safe navigation, and the time that can be spared to the elucidation of purely scientific problems is limited.

Nevertheless, the daily work of the surveyor is so intimately connected with these scientific problems that year by year, slowly but surely, we add to the accumulation of our knowledge of the sea.

Col. H. W. Feilden (the Naturalist to Sir George S. Nares's expedition in 1875–6), read a paper on *Current Polar Exploration*, beginning with Nansen's enterprise, of which he said:

I know of nothing in the entire history of Arctic adventure that surpasses the boldness and audacity of Nansen's conception. The risk he has calmly and voluntarily undertaken is tremendous. In what particular part of the Polar area the *Fram* may now be is a matter of hypothesis. After Nansen got beset in the Polar pack, his vessel must be entirely under the influence of the ice-drift. Neither steam nor wind can help her in any appreciable manner. We have every reason to believe that there is a steady circulation of water around the Pole, independent of the surface movements of the ice, caused by winds. This is proved by the fact of an ice-stream of enormous proportions flowing from the Polar area along the east coast of Greenland, passing between that island-continent and Iceland, glaciating Greenland and Cape Farewell, which latter lies in about the same latitude as the Shetlands, and finally meeting the Gulf Stream off the coasts of the United States. The smaller current which sets down Smith's Sound, between Grinnell Land and North-west Greenland into Baffin's Sea, points to the same conclusion. In my view the most hopeful indication of there being a tolerably rapid movement across the Polar area lies in the fact that the coast line of Grinnell Land, from Cape Union to the north-west, as far as it was explored by Sir George Nares's expedition in 1875 and 1876, is strewn with drift-timber, and

the same occurs on the north shore of Greenland, from Repulse Bay to Cape Britannia. I paid particular attention to this drift-wood during my stay in Grinnell Land in 1875–76, and found that it was all coniferous. Though sadly battered by contact with the ice-floes, it often appeared comparatively fresh, pieces of bark adhered to it, and the abraded roots showed that the trees had been washed out whilst growing from the river banks. Now, there cannot be a doubt that this wood came from the Lena, Yenesei, or from some of the great rivers of Siberia. That this drift is constant and must have lasted for ages without any intermission is proved by our finding identically the same description of timber at all heights up to 1,000 feet in Grinnell Land. Even at this great elevation the timber had not lost its power of flotation, and burnt with a dull glow. You must not, however, suppose that this timber had been exposed to the elements for the long period that must have elapsed whilst Grinnell Land rose 1,000 feet above its present sea level. Stranded in fiords and bays it had been covered with glacio-marine mud-beds, filled with shells of recent Arctic mollusca and remains of mammals, &c. The melting ice-torrents subsequently cut through the mud-beds, and we wandered along dreary valleys, flanked by mud cliffs, and at the high elevations I have mentioned our footsteps crushed the shells of mollusca still retaining their brown epidermis, and held together by their hinges, whilst pieces of drift-timber were strewn around. A month ago, when in Spitzbergen, I carefully examined the drift-timber at the head of the bays and fiords which we visited. Precisely the same phenomena are visible in Spitzbergen as in Grinnell Land, so far as the secular elevation of the land is concerned, and the formation of glacio-marine beds; but the drift-timber of Spitzbergen is of quite a different description to that of Grinnell Land; some of it is baulks, and wood that has been used by man; it is evidently the *refectamenta* of the Gulf Stream and Atlantic Ocean, whilst the Grinnell Land drift undoubtedly comes from Siberia. I have entered into this long digression to indicate that there may be some hope of Nansen's audacious and magnificent project being safely accomplished; but, even if the *Fram* is lost, I have such confidence in the boldness and resource of the leader that I believe he and his companions will return to civilization.

Col. Feilden briefly noted the safe arrival of the Jackson-Harmsworth expedition at Archangel, and cautioned his hearers against the generally accepted belief that a successful landing on Franz Josef Land was a mere matter of detail. The later news received concerning the expedition justifies this caution.

He then referred to the loss of the *Ragnvald Jarl* and the abandonment of Mr. Wellman's dash at the North Pole. Feeling satisfied that the young journalist and

his companions were once more in safety, Col. Feilden said:

Skill in Arctic navigation can only be attained by experience, and I venture to lay it down as a canon that the leadership of such an expedition should only be intrusted to a scientific sailor who has had such experience. In the case now before us, we have a plucky young American leaving his editorial chair in Washington and, without any practical acquaintance with ice navigation, crossing the Atlantic, hiring a ship in Norway, collecting his party of various nationalities, and starting off helter-skelter to make a rush for the North Pole, or to attain a very high northern latitude. Mr. Wellman's project (he gave it to the public through the Press) before he left for Spitzbergen was to place a depot on Danes Island, almost the north-western point of the Spitzbergen group, steam up to the Polar pack, jump off, and with dogs and sledges race over the floes. This, however, is a task far more difficult to accomplish than to set. The edge of the polar pack along the North Atlantic is not a solid line of ice, like a wharf or shore line; it is a confused mass of fragments, sometimes pressed together in chaotic forms, again opening out into loose ice under the influences of winds and currents, and leaving water spaces that a ship can pass into the favorite resorts of the whalers in old days. You must penetrate far into the pack, as Sir Edward Parry did in 1827, before you can hope to get on to an ice floe of sufficiently homogeneous nature and of sufficient extent to enable the travellers to pull their sledges and boats over its rough surface. Parry placed his ships in safe quarters in a convenient bay on the north of Spitzbergen, and after securing his base proceeded in rowing boats through the loose pack, until he found sufficiently firm ice to drag his sledges. We all know the result of his splendid endeavors. Parry found the southern drift of the ice-floes greater than his daily advance, so he was forced to abandon the enterprise, but for nearly 50 years his achievement marked the highest northern latitude attained by man, until his countrymen, under Sir George Nares and Admiral Markham, exceeded his limit, which was again surpassed by Lockwood in 1882 by 4 min. Mr. Wellman rushed his ship into the Polar pack, with the result that every student of Arctic literature could have foretold. So impressed was I with the extreme risk of Mr. Wellman's programme that when Captain Townley Parker invited me to accompany him this summer on board the R. Y. S. *Saide*, with a hint that our voyage might be extended to Spitzbergen, I gladly accepted his kind offer. Captain Parker before leaving England in May determined to visit Danes Island and convey European news to the members of the expedition that we expected to find there. The 27th of June saw us at Tromsö, with exactly one month in hand before the *Saide* had to be in Southampton Water. The yacht was filled up with coal to her utmost capacity—30 tons in the bunkers, and a deck-load of 20 tons in addition. This caused us considerable anxiety, as, after getting outside the islands off the Norwegian coast, on the morning of June 28th, we met with heavy weather, with a strong gale from north-west and rain and fog, and as we shipped a good deal of water we were greatly afraid that our precious deck-load might have to be thrown overboard.

Our course was laid for Bear Island. At mid-day of the 29th the ship was hove to for a couple of hours. Weather moderating, we proceeded under steam, and at 6 P.M. were fortunate enough to obtain good sights, which placed our position 67 miles out of our course to the eastward of Bear Island, so strong had the current been. Strange to say, we sighted no ice; it must have been all driven eastward by the gale. Altering our course, we steered to the north-west between Bear Island and Spitzbergen, and sighted Bear Island for a short time through the fog at 3 A.M. of June 30. At 4.30 P.M., the fog rising, the South Cape of Spitzbergen came into view 20 miles distant. Beautiful weather now set in, and the evening of July 1 saw us safely anchored in Advent Bay, Ice Fiord. There we were detained four days, partly to take in a supply of reindeer meat, and also by our finding the wreck of a Norwegian hunting vessel, and two days were spent in hunting for traces of the shipwrecked crew. Our efforts failed; the crew must have perished, but we brought away documents and clothing which showed their identity, and these were handed over to the Norwegian authorities on our return to Tromsö. We also had the advantage of sailing in with Edward Johannessen, of the *Anna*, and hearing his views about the *Ragnvald Jarl*. Early on July 5 we left Ice Fiord, and, steaming northward through a sea like oil, we passed outside Prince Charles's Foreland, and at 6 A.M. on July 6 we rounded Hakluyt's Headland and anchored in Smeerenberg Bay. There we found Captain Olsen of the *Familien*, driven down by the closing pack from the north-east, and his view as to the destruction of the *Ragnvald Jarl* was as positive as that of Edward Johannessen. Getting out the launch, we communicated with Professor Oyen on Danes Island, and left him a good stock of creature comforts. At 5 P.M. we had returned to Danes Island in the launch, steam was up, and Capt. Parker determined to run as far as he could in the direction of the Seven Islands to look for Wellman. Captain Olsen very kindly came on board the *Saide* to act as pilot if the pack forced us to run in close to the Spitzbergen shore, and I take this opportunity to acknowledge his services for he guided us, when nearing the shore, from several dangers and spots of foul ground, which, of course, we were unacquainted with, having no one on board who had previously visited this part of Spitzbergen. Leaving Smeerenberg Bay at 5.30 P.M. on the 6th, we headed north-north-east. At 9 o'clock the blink of the ice showed up, and by 10 P.M we got into loose sailing ice, in 80° 10′ N. The main pack was about two miles from us. I may mention that the *Saide* is entirely unprotected, and quite unfitted for contact with the ice-floes, and it would have been folly to enter close ice. As I viewed the pack from aloft it appeared to me of a formidable description, much of it floating 7 ft. to 8 ft. above water. The sea was as smooth as glass; not a breath of air disturbed the surface. The ice between which we glided showed all the lovely colours, from sapphire to emerald, which the memory of the Arctic voyager loves to dwell on. Altering our course to the eastward, we skirted the pack, working down the edge of it until we got abreast of Grey Hook. There we found the pack stretching in a semi-circle, enveloping Moffen Island, firmly wedged on Verlegen Hook, and stretching to Grey Hook. Wijde Bay appeared to be completely closed with ice. Knowing that there are no safe harbours amongst the Seven Islands, and that a

ship lying there must be exposed to the almost certain risk of being beset and pressed on shore, and taking into consideration the very formidable character of the pack, I came at once to the same conclusion as the experienced walrus hunters, and felt that only a miracle could save Wellman's ship. It being quite impossible in our unprotected ship to get further east, and our coal supply having to be considered, nothing was left but to turn round and return to Smeerenberg Bay. About 1.30 on July 7 a complete change of weather took place. A heavy gale came up from the south-west, and we were glad, after a good shaking, to find ourselves, at 5 A.M., at anchor again in Smeerenberg Bay. All through July 7 the gale raged outside. Early in the morning of the 8th we proceeded to sea, and, again rounding Hakluyt's Headland, set our course to the southward. Captain Parker and I having come to the conclusion that Wellman's expedition had in all probability come to grief, it was deemed advisable to steam direct for Tromsö, taking with us Mr. Wellman's despatches and letters that had been left by him at Danes Island in May. The *Saide* reached Tromsö on July 12, and our views were at once circulated by the press. Though the definite news of the loss of the *Ragnvald Jarl*, on May 28, off Walden Island, did not reach Europe till August 2, the information brought by the *Saide* had quite prepared the authorities in Norway for the actual result, and the three weeks for preparation, which our information gave, was of considerable importance. I think, when I tell you that Captain Townley Parker is over 70 years of age, you will compliment him on his vigour and energy.

Col. Feilden closed with a reference to the magnificent work of Peary and his Norwegian friend, Astrup, in North Greenland, as of the highest geographical importance, and declared that all were looking forward with intense interest for their safe return by the end of September.

In Col. Feilden's opinion, North Spitzbergen is preferable to any other point as a base for expeditions in the direction of the Pole.

Dr. Hugh R. Mill offered the results of a bathymetrical survey of the English lakes. There are two types: one, represented by Derwentwater and Bassenthwaite, is broad and shallow, with an undulating bed, grooved and ridged; the second, comprising the other lakes, is characterized by steep sides and an almost flat floor. The following table shows the length, depth

and volume of these lakes, as ascertained by Dr. Mill and his associates :

NAME.	Length, Miles.	DEPTH, FEET.		Volume, Million Cubic Feet.
		Max.	Average.	
Windermere	10.50	219	78½	12,250
Ullswater	7.35	205	83	7,870
Wastwater	3.00	258	134½	4,128
Coniston	5.41	184	79	4,000
Crummock	2.50	144	87½	2,343
Ennerdale	2.40	148	62	1,978
Bassenthwaite	3.83	70	18	1,023
Derwentwater	2.87	72	18	1,010
Haweswater	2.33	103	39½	589
Buttermere	1.26	94	54½	537

Mr. H. N. Dickson described his observations on the currents of the Faröe-Shetland Channel and the North Sea :

At all seasons Atlantic water is drawn from the Faröe-Shetland Channel and forced into the North Sea by the tides between Orkney and Shetland. The tidal streams run N. W. and S. E., and an eddy is formed to the northwest of the Orkneys, into which North Sea water is drawn, and perhaps also water from below. As the season advances the surface water of the North Sea becomes warmer; the upper layers probably receive smaller supplies of fresh water, but they become specifically lighter than the under layers. The upper layers becoming warmer than the Atlantic current, the surface of the North Sea becomes higher, and the surface water spreads into the Faröe-Shetland Channel, checking the supply of Atlantic water. Meanwhile the mass of Atlantic water seeks entrance into the North Sea. The controlling conditions are complex, but it appears that the greater the winter cold and the spring supply of ice-cold water from the Continent, the more slowly will Atlantic water penetrate into the North Sea below the surface; and the warmer the summer, the more will the surface supply be checked. At the same time the warmer the summer, the larger the quantity of Atlantic water seeking admission, and the greater its thermal power to drive back the axis of *maximum* weight.

Mr. H. Yule Oldham, in a paper entitled *A New Light on the Discovery of America*, indicated the three

easiest points of access on the Atlantic Coast of the New World :

(1.) North America, by means of the convenient stepping-stones, Iceland and Greenland ; (2.) Central America, with the help of the steady northeast trade-winds ; (3.) Brazil, in South America, which is not only the nearest point to the Old World, but has the additional advantage of winds and currents tending in its direction. The Norsemen undoubtedly reached America by the first route ; and Mr. Oldham's argument seems to be that, because the other routes were open, some discoverer or discoverers must have taken advantage of them before Columbus. Something like this may have been said before, but a man has the right to free his mind and to believe in discoverers who hide what they discover.*

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* Mr. Oldham has found a MS. map drawn by Andrea Bianco in 1448, and on this map an island, denominated *Authentic Island*, appears within the space occupied by Brazil in modern maps. This island Mr. Oldham is disposed to identify with the land said to have been discovered in the west by some Portuguese in the year 1447, as related by Antonio Galvano, in his *Discoveries of the World*, translated and published by Hakluyt in 1601.

The identification may be allowed, but it proves nothing. In every age chroniclers and map-makers accept statements and data which will not bear the light of fuller knowledge.

Galvano (whose name should be written Galvão or Galvam) gives the following circumstantial account, under the year 1428, of two maps much more remarkable than the one presented by Mr. Oldham:

" In the yeere 1428 it is written that Don Peter, the King of Portugals eldest sonne, was a great traveller. He went into England, France, Almaine, and from thence into the Holy Land, and to other places ; and came home by Italie, taking Rome and Venice in his way: from whence he brought a map of the world, which had all the parts of the world and earth described. The Streight of Magelan was called in it The Dragons taile: The Cape of Bona Sperança, The forefront of Afrike, (and so foorth of other places:) by which map Don Henry the Kings third sonne was much helped and furthered in his discoueries.

" It was tolde me by Francis de Sosa Tauares, that in the yeere 1528, Don Fernando, the Kings sonne and heire, did show him a map, which was found in

The Climatology of Tropical Africa was the subject of a paper by Mr. E. G. Ravenstein:

He said that by ascending a mountain we might, even in tropical Africa, enter a region the mean temperature of which coincided with that of England, but if we at the same time considered the annual and daily ranges of temperature, we should find that a tropical climate differed exceedingly from that of the temperate regions. In the latter, the annual range was considerable, the daily range small. The character of a tropical climate was the very reverse, for there the difference between the coldest and warmest months of the year was small, while the difference between the temperature of day and night was very great. Nor could we escape these features even though we ascended the loftiest mountains to be met there. These conditions inevitably led to anæmia and racial degeneracy. Malaria prevailed throughout, even on the plateaus, and some of those explorers who had been loudest in praising the climate as being thoroughly well adapted to European constitutions had fallen victims to its deleterious influences. Europeans might certainly "live" in Africa with occasional holidays in Europe, and they could superintend native labour, but no locality had been discovered as yet where it would be advisable for European agriculturists and colonists to settle down. The districts most favourable to European settlers appeared to him to be some of the hill stations and the steppe-like plateaus which occupied so large an area in Eastern Africa, and extended southward into Cape Colony. Speaking of the rainfall, Mr. Ravenstein said that it was sufficient in most parts, but very irregular, so that works of irrigation would be required wherever agriculture on an extensive scale was to be carried on. The humidity, which in combination with great heat produced a climate very trying to the strongest constitutions, was, fortunately, not excessive over a considerable portion of Africa, including all the steppe-lands.

Mr. J. T. Buchanan described the researches made by the Prince of Monaco in the Atlantic and the Mediterranean in the summer of 1894. The tempera-

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the studie of Alcobaza, which had beene made 120 yeeres before, which map did set foorth all the nauigation of the East Indies, with the Cape of Bona Sperança, according as our later maps have described it. Whereby it appeereth, that in ancient time there was as much or more discouered, then now there is."

The final reflection, *whereby it appeereth*, is too freely rendered by Hakluyt. Galvano did not quite believe what he was told. He says: *Se assi he isto*, "if this is so," then in ancient, etc.

One consideration disposes of the matter. The Portuguese were wholly possessed by the spirit of maritime adventure. If they had learned in 1428, or in 1447, that there were lands beyond the Atlantic, they would have discovered the West Indies and Mexico and Central America and the South American Coast before the year 1492.

ture of the surface ranged between 15° and 17.4° Cent. (59° to 63° Fahr.), but rose under the influence of hot winds to 28° Cent. (82° Fahr.). In dredging, 89 black ground sharks of a very rare species were brought up from a depth of 7,316 feet, and some fishes, not yet identified, from a depth of 11,844 feet.

The geography of Lower Nubia, the region which will be flooded by the proposed Nile reservoir, was described by Mr. Somers Clarke, who held it to be of the utmost importance to make an exhaustive scientific investigation of the valley before it is drowned, with the temples of Philæ. Mr. Norman Lockyer thought that all the temples should be carefully surveyed and all the inscriptions transcribed and translated.

Mr. Peary's Greenland Expedition.—The steam sailing vessel *Falcon* arrived at St. Johns, N. F., on the 15th of September, bringing all but three of the North Greenland Expedition. Mr. Peary remains in the Arctic, with two volunteers, Hugh Johnson Lee and Matthew Henson, and will make an attempt during the next season to complete the work which was interrupted this year by the severity of the weather and the consequent reduction of the working force. The following letter to the New York *Sun*, of Sept. 16, relates the experience of the party:

"I was unable to carry out my plan last spring to reach Independence Bay, on the northeast coast of Greenland, on account of the terrible weather which set in after we had started on our journey. As I had planned, I made a very early start. We set out from Anniversary Lodge on March 6. The winter night was at an end, and the sun had risen above the horizon about two weeks before. The party comprised eight men—Astrup, who was my companion on the journey to the northeast coast in 1892, and Messrs. Entrikin, Lee, Baldwin, Vincent, Davidson and Clark. We had ninety dogs and twelve sledges. Five natives assisted us during the first two days of the march.

"Our intention was to make straight over the inland ice for Independence Bay, about 650 miles away. Our course was to be about midway between my outward and homeward track in 1892. Eight days after we started Lee and Astrup were compelled to return to our winter quarters. Lee had a frozen toe that rendered it impossible for him to go on with us. Astrup was ill and unfit for further marching. We were therefore crippled from the start, for we needed all hands if we reached the north coast in order to carry out my plan of dividing the expedition into three parties, each to undertake a certain part of the work.

"For the next six days, to March 20, we made slow progress, and on that day we were compelled to go into camp after making three miles. We could make no progress against the furious head wind. The temperature was 35° below zero. Entrikin, Baldwin and I occupied one hut, and Vincent, Clark and Davidson were in the other. Here we were imprisoned by the blinding storm for three days. On the 22d inst., two days after we went into camp, Vincent, Clark and Davidson were compelled to retreat to our tent to escape smothering. Davidson and Clark were considerably frostbitten.

"The storm subsided on the 23d inst., and we had our first opportunity to inspect the condition of the camp. We dug the dogs out of the snow that buried them. They were in a most pitiable condition. Some were dead and frozen solid under the snow. Many were frozen fast to the ice, and we had to chop them loose. The anemometer showed that the average wind velocity for thirty-four hours was forty-eight miles an hour. The thermograph showed that the average temperature had been 50° below zero. The lowest temperature during the storm was 60° below zero. We were encamped on the ice cap, 5,000 feet above the sea. I believe that this was the severest storm ever experienced by an Arctic party on a sledge journey.

"Davidson's frost bites made it necessary for him to return to Anniversary Lodge. Clark desired to continue with us. Davidson could not return to the winter camp alone, and so Dr. Vincent was detailed to go with him. They left us on March 24, and then our party was reduced to four men.

"We resumed the march. On the 28th inst., in a furious gale of wind, and with the snow drifting badly, Entrikin repaired a sledge, and while at this work he froze his feet badly. Still I determined to keep on, and we struggled ahead, fighting wind and weather as best we could until April 10. The dogs suffered greatly. They could not rally from the effects of the terrible equinoctial storm through which we had passed. Deaths occurred among them every day. To our dismay we found that the piblockto, or Greenland dog disease, which for many years has from time to time made great ravages among the native dog teams, had gained a firm foothold among our animals. We faced the probability that we would soon have no dogs to draw our sledges.

"The facts that my dogs were being exterminated, that we were still less than one-fourth the distance on our way, and that the season was getting late, decided me to return to our winter quarters and to save what provisions, alcohol, and so on, I could for another trial on the inland ice next spring. At our halting place, 125 miles on our journey, I cached a good quantity of supplies,

and erected a prominent signal that will enable me to identify the spot next spring. Then we began the retreat under much difficulty.

"Entrikin's feet were now swollen and painful, and he was unable to walk. The dogs were dying every day. Clark and I were affected to some extent by snow blindness. The best day's march we had made to the north was eighteen miles, and we had to take a slower pace home. We reached Anniversary Lodge on April 20.

"Then we tried to do what work we could in the south. As early as possible, after his return to winter quarters, Astrup set out for Cape York, 150 miles to the south, and he was fortunate in being able, early in May, to complete the survey of the northern coast of Melville Bay. Most of the shore line of this bay, as is well known, had not been determined by earlier explorers.

"On May 16 I set out with Lee in search of Ross's Iron Mountains, near Cape York. After a journey of three weeks, during which the weather was incessantly stormy, we returned, having found the famous stones, which I photographed and measured. I built a cairn and deposited the record of the first white man who had looked upon them. When the *Falcon* took my party on board to return south I accompanied her to Cape York, and hoped to send one of the meteorites home by her, but the ice prevented the ship from making land. I hope I may have better success next season.

"Early last fall we carried supplies up on the ice cap for the spring sledging campaign. We were assisted in this work by the natives and the burros or Mexican donkeys that I had taken north. We were, however, able to carry the supplies only twenty-six miles inland.

"On Oct. 31 we met with quite a disaster. A tidal wave swept up Bowdoin Bay and washed up high on the beach where our house had been built. My steam launch, *Gen. Wistar*, was stove in. The whaleboat *Faith*, which had been part of my equipment on my expedition of 1891–2, was wrecked. My dories were also destroyed. All the barrels of kerosene had been scattered along the shore at some distance from one another. They were all swept into the sea, and only one-half of them were recovered. It was thus impossible to make use of the electric light plant during the winter.

"We occupied the winter in making preparations for the northern sledge trip. The manufacture of sledges was one of our chief occupations. We made sledge journeys by moonlight to secure food for our large number of dogs, and about 700 miles were thus covered. My burros did not live through the winter, and proved to be of little use. The carrier pigeons were destroyed by hawks and Eskimo dogs.

"The spring and summer before the *Falcon* came to take us home were devoted to surveying the neighboring bays and hunting deer. Two hundred and fifty deer were killed by the party. The auxiliary party on the *Falcon* was prevented by heavy ice from opening up communication with me until August 1, and the *Falcon* was not able to push her way through the ice up Bowdoin Bay and reach Anniversary Lodge until August 20.

"The auxiliary party made a trip to Ellesmere Land and searched the Carey

Islands for traces of the lost Swedish explorers, Björling and Kalstenius. They found some relics of them and the skeleton of a man on the Carey Islands, probably a sailor. They found no trace of the lost explorers at Cape Faraday or Clarence Head on Ellesmere Land, where it was hoped by the friends of the explorers that they had taken refuge. Jones Sound, south of Ellesmere Land, was blocked with ice, and it was impossible to push into it, so no exploration could be made in that direction.

"Mrs. Peary will return home with a daughter, aged one year, and accompanied by an Eskimo nurse from Bowdoin Bay.

"I shall make another attempt on the ice cap next spring. I shall utilize the Eskimos as a supporting party. They have done me good service throughout my sojourn in northwest Greenland, and I believe I will find them effective helpers on the inland ice. I have ample supplies of all sorts, including plenty of coal for the winter. All of the party are in good health.

"I am now, on August 29, about to leave the *Falcon* off Petowik Glacier, a little north of Cape York. The *Falcon* will proceed home, and I shall return in a whaleboat with Matt Henson and my Eskimo crew to Anniversary Lodge.

"R. E. PEARY."

It is not to be expected that the unfavorable conditions of 1894 will be renewed in 1895. Mr. Peary will undoubtedly finish what remains to be done in North Greenland, with which region his name is now permanently associated. Prof. Guido Cora proposes, in *Cosmos*, Series II., Vol. XI., Fasc. X.–XI.–XII. that the channel which bounds Greenland on the northeast be called by the name of its discoverer, and in his careful map of the coasts from Smith Sound to Lincoln Sea and Independence Bay, showing the results of the expeditions for the period 1871–1892, Peary Channel finds its appointed place.

The following extract from a letter, printed in a later number of the *Sun*, describes the unsuccessful attempt on the ice-cap:

On Tuesday morning, March 22, although the weather was still very unfavorable, we got under way, but the furious head wind and stinging drift, with the temperature of —35°, compelled us to halt after going only three miles, the dogs absolutely refusing to pull. Here we camped. Entrikin and Baldwin, with their double sleeping bag, took up part of the light protean tent, while the alcohol

cooker and myself took the rest. The Doctor, in a single bag, and Clark and Davidson in a second double bag, occupied Astrup's little silk tent. The dogs were fastened as usual, each team was divided into groups, and, dinner over, we turned in. About 5 o'clock next morning I was awakened by a sudden increase in the force of the wind, which now blew with such violence that, had not our tents been all in one piece, connected with the floor cloth on which we were lying, I should have expected to have had it blown away at any moment.

The drift which accompanied this storm was almost indescribable, and had the members of the party been any less perfectly clothed than they were, it would have been impossible to have gone out of our shelter. As it was, however, Baldwin made his regular observations at the observatory sledge about 100 feet from the tent, and he and I took turns in carrying hot tea and pea soup to the three men in the silk tent, about fifty feet distant. Throughout the day and the following night the wind steadily increased in violence, until it became impossible to shout so as to be heard from one tent to the other, even with the utmost effort of our lungs.

On Thursday afternoon the drift forced an entrance into the silk tent, and in order to escape being smothered its occupants were obliged to get out as best they could and retreat to the larger tent. In doing this Davidson had his heel, and Clark a toe, two fingers and a thumb frost-bitten. As soon as they were safely in our tent, Entrikin turned out of his bag and gave his place to Clark. I turned my deerskin sleeping trousers over to Davidson, and the Doctor curled himself up on the foot of the big bag. This left a small space between the pole and the tent opening, in which Entrikin and I could stand. This space was constantly decreasing in size from the drift, which, in spite of our efforts, continued to force itself through the fly, after the entrance of the boys. After a time there was room for only one of us, and we alternated in standing up, steadying ourselves by the pole, now and then curling up on the snow drift for a few winks of sleep, and making tea several times during the night to warm up the boys and keep up their spirits. The straining and flapping of the tent, the deafening roar of the wind, the devilish hissing of the drift, the howling and screaming of the poor dogs, made a pandemonium never to be forgotten.

One consoling feature was the fact that, owing to the quality and construction of our fur clothing, no one of the party suffered severely from the cold while in the tent. Personally, though without sleeping bag or any other covering beyond my deerskin travelling garments, I was entirely warm and comfortable throughout the storm.

Early on Friday morning, March 23, the wind began to subside, and at 7 A.M. I was out looking upon a scene that made me sick at heart. Half my dogs were frozen fast in the snow, some by the legs, some by the tails, and some by both. Two were dead, and all were in a most pitiable condition, their fur a mass of ice and snow driven into it by the pitiless wind. Several had freed themselves and had destroyed the double sleeping bag and many of the harnesses which had been blown off the tripods. Baldwin's anemometer, barograph and thermograph, which, as the result of his ingenuity and perseverance, had kept on recording

throughout the storm, showed that for thirty-four hours the average wind velocity had been over forty-eight miles per hour and the average temperature about —50° Fahr., with a minimum of over —60° Fahr. When these figures are considered in connection with our elevation of 5,000 feet, the unobstructed sweep of the wind, and the well-known fact that ice-cap temperatures accompanied by wind are much more trying to animal life than the same temperatures at sea level, it is believed that the judgment will be that this storm beat the record as the most severe ever experienced by any Arctic party. All Friday was spent in digging out the sledges, feeding the dogs, getting them in shape as far as practicable, and making and repairing harnesses.

Davidson's heel placed him entirely *hors de combat,* necessitating his return to the lodge, and I decided to send him back in charge of the Doctor. I made arrangements for them to start early on Saturday morning. Clark's frost-bitten hand was not injured to speak of, the effect being superficial only. His feet, however, were frost-bitten in several places, and, while their condition at present was not such as to incapacitate him from travelling, the chances were perhaps more than even that additional exposure might make them worse. As he, however, had said nothing of turning back, and I knew him to be desirous of keeping on, I felt that I could not send him back if he, after thoroughly understanding the *pros* and *cons* of the case, still wished to go ahead, and was willing to assume the entire risk and responsibility as to his own personal safety.

I told him, therefore, that it he went on beyond this point, and should have more trouble with his feet, he would be obliged to return alone on a ski, without sledge or dogs, as I could neither spare another member of the party nor dogs to bring him back.

I told him to talk the matter over with the Doctor and let me know his decision. An hour or two later, finding him at work on some harnesses, I asked him if he had made up his mind. He answered in his deliberate Yankee way, as if anything different had never occurred to him :

"Oh, I guess I shall go ahead all right, sir ;" and go ahead he did.

Thick weather delayed the departure of Dr. Vincent and Davidson till noon, when they finally left us, the Doctor afoot and Davidson wrapped in the fragments of the sleeping bag and seated upon one of the seven-foot sledges, drawn by five dogs. This further reduction of my party to four destroyed all possibility of carrying out my original programme. I felt that the party thus reduced should remain a unit, and this meant either the entire abandonment of the east coast work or its execution by the same party that did the northern work after its return to Independence Bay.

After they had gone the afternoon was devoted to strengthening and sewing up holes in the tent, and repairing the torn sleeping bags. A cache was also made of the supplies that were now superfluous owing to the reduced size of the party. A complete readjustment was made of sledges and loads. At night all four of us occupied the protean tent, Entrikin and Baldwin as usual in their double bag, and Clark in the Doctor's single bag, to which he had fallen heir.

I turned in with my feet thrust in an extra pair of dogskin trousers, and felt

no need of any other covering. The next day we left camp, Entrikin, Clark and Baldwin each with a large sledge and a smaller trailer in tow, drawn by teams of eighteen dogs. This arrangement was necessary to enable us to take all of the supplies. What the handling of teams like this means only those who know something of the peculiarity of the Eskimo dog can understand. In spite, however, of their two days' rest after the storm, it troubled me to find that my dogs were not in condition, and after travelling seven miles in a temperature of —46° Fahr., with a fresh, south-easterly wind, we were obliged to halt and camp on their account.

The following day gave early promise of being a favorable one, but we had travelled only a short distance when the wind and drift met us again, and at the end of three miles forced us to camp. Tuesday, the 27th of March, was a bright sunshiny day with just a light north-easterly breeze, and comparatively high temperature (—30° Fahr.). The demon of the ice cap, however, had only begun to play his cards. Less than two miles away from the camp Baldwin's big sledge, while going over a huge marble-like sastrugi,* broke in the bend of one of the runners, and we were delayed an hour or two lashing another sledge alongside it, making a three-runner sledge. At the end of the fifth mile Entrikin's sledge, the "Long Serpent," ran upon the sharp edge of an ugly, ragged sastrugi, and hung there broken-backed. This ended the day's march, and we went into camp to unload and repair both sledges.

This was the first day since leaving the cache igloos that we had been able to see more than a few yards about us. The surface of the inland ice lay in long swells. Each successive one was slightly higher than the preceding, and all rose somewhat higher to our right and descended somewhat lower to our left. The surface was firm, yet cloth-like in texture, and the rasping of the sledge runners over it came to my ears crisp and resonant, even when three-quarters of a mile away. At frequent intervals were huge sastrugi, offspring of the storm, marble-like in whiteness and hardness, all pointing toward Kane Basin, whence the equinoctial storm had issued, and which, hurtling across the icy canopy of Prudhoe Land, had fallen upon the party at Equinoctial Camp.

Throughout the entire march there were constant mirage effects, causing curious distortions of the members of the party, sledges and dogs; and a white frost cloud of condensation accompanied each team. A brilliant parhelion also displayed its prismatic colors for an hour or two during the day. At this camp three of the dogs that were unable to go on were killed and used as dog food. After the dogs were fastened and fed, I found that the boys were so discouraged by the mishaps of the day that I made no attempt to have the sledges repaired, but fixed up a milk punch and had every one turn in.

The next morning the temperature by the spirit thermometer was —51° Fahr., rising later to —36° Fahr., but accompanied then by north-east winds and drift. In this weather and temperature, and without shelter, Entrikin and Baldwin repaired their sledges, and Clark overhauled and repaired all the harnesses. This

* The *sastrugi* are long, wave-like ridges in the snow, perpendicular to the wind.

simple statement conveys no idea of what this work really meant. While engaged in it Entrikin got the bottoms of his feet nipped, and this was the beginning of his serious trouble.

After his work was done the "Long Serpent" was a much stiffer and easier running sledge than before, and I had hopes that it would last to Independence Bay. Although it was after 6 o'clock when the sledges were completed, we harnessed up and went on for a few miles rather than camp a second night in the same place.

During this march the wind and temperature, acting upon the moisture of Baldwin's breath, froze his kooletah so rigid that he could neither walk nor turn his head, and was obliged to come into camp riding on his sledge. Here we were obliged to assist him in removing the ice and snow, which had almost completely closed the face opening of his kooletah.

The next day was clear, with temperature ranging from —36° to —40° Fahrenheit. With everything in repair and good surface over which to travel, we should have made good progress, but the wind and drift directly ahead were on hand again, and at the end of ten miles Entrikin's team balked, and, in spite of the assistance of Baldwin and myself, refused to go further. In his efforts to start the sledge, Entrikin strained his back, and this, together with his frost-bitten feet, put him in a decidedly sober mood. The next morning, when we awoke, Clark's nose, which had projected too far through the face of his kooletah, was frozen to his sleeping bag, and had to be thawed off by the warmth of the hands.

Entrikin was in no condition to march, so we remained in camp to give him a chance to rest and get in condition. The temperature during the day was well down in the minus forties, falling at 7 P.M. to —55°, and remaining throughout the night between —55° and —57° Fahr.

Every one except myself passed an exceedingly comfortless night. Being unencumbered by a sleeping bag, I was able, if my feet got chilly, to restore the warmth by pounding them upon the snow.

The next day we pushed ahead five miles more, but the work showed that Entrikin was not in trim to stand a good day's march. The continued low temperature, too, in the forties and fifties below zero, with the almost constant wind, gave my dogs no chance to recover from the effects of the equinoctial storm, and had a perceptibly numbing effect upon the physical and mental faculties of my party. One of my best dogs died this day from the effects of that storm. Several had frost-bitten feet, and were unable to pull properly. Others were passing blood. Lion, the hardy veteran of the previous trip, was laid up with a sore leg, and almost all the animals still had more or less of the snow of the equinoctial storm remaining in their coats.

As a last resort I decided to remain in this camp two days to give Entrikin a final chance, and to see if it was possible to get the dogs in any better condition. Throughout these two days the temperature was well down in the forties, below zero. The temperature in the tent at my head for the two mornings was 45° and 44° respectively. (45° and 44° below zero must be meant.)

On the morning of April 3 Entrikin's feet and back were in much better con-

dition, and I felt encouraged to think that he could now keep on without further trouble. The going during the day was very good, the surface hard, smooth, and level, interrupted only occasionally by the big sastrugi. At the end of the day's march we had covered fifteen miles, but the encouraging effect of this was more than counteracted by an occurrence which gave me more uneasiness than any other mishap thus far. One of the dogs in Clark's team was attacked by the piblockto, and bit nearly all the dogs in both Clark's and Baldwin's teams before he was shot.

On April 4, for the first time, the day passed without mishap, and the end of the march found us 15¼ miles from the last camp.

The next day again we advanced fifteen miles. Soon after making camp at the end of this march it began snowing heavily, with a strong south wind. This was the beginning of a storm that confined us to the tent for the next three days, and gave the finishing stroke to my poor dogs. When the storm ceased many of them were buried completely in the snow, several frozen down, and two were dead from exposure. All our sledges were completely snowed in, and the tent itself half buried in a big drift.

The following march was only seven miles, and this distance was made with the utmost difficulty. Entrikin's feet were much worse, and two more of the dogs with the piblockto had bitten nearly every dog in the pack. One of these dogs, the Agitator, a powerful big wolfish brute, the last survivor of the dogs purchased on the Labrador coast, presented, just before he was killed, as savage and gory a spectacle as I have ever seen. He had run amuck through the team, and, half blind as he was with froth and blood, had been mercilessly torn and shaken by the dogs that he had attacked. As the rifle was leveled at him he stood exhausted and panting, with head and neck swollen to twice their natural size, ears torn in shreds, eyes bloodshot, bloody foam dripping from his jaws, and his entire body flecked with foam and blood and clotted tufts of fur. Though so weak that he could scarcely stand, he was just gathering himself for another spring at the dog nearest him, when the bullet passed through his brain, and he collapsed in a quivering heap on the blood-bespattered snow.

It was very evident that the dread disease had gained a firm foothold in my pack, and the end could not be far away.

On April 10, after taking an account of stock, so to speak, and turning the whole matter over carefully, I decided that it was not advisable to attempt to proceed any further this season. As to the condition of my party, Entrikin was now entirely out of the race with his frosted feet, and must return to the lodge. Baldwin was not entirely recovered from an attack of cramps at the last camp, and I feared another storm would bring them on again. Clark had both heels and great toes frost-bitten, and was having daily attacks of bleeding from the nose. All, however, showed true grit, and were willing to push on. But the crushing blow was the existence in my pack of the dreaded and incurable piblockto, induced by the extreme exposure of the past four weeks, and which, with continued work and exposure, might easily reduce my pack to half its present number, or even exterminate it entirely.

Another serious feature of the case was the lateness of the season. Instead of being at Independence Bay on the 1st of April, as I had planned, it was now the 10th, and we were only one-fourth of the way there. While I appreciated the fact that two, or perhaps three of us, could probably get as far as Independence Bay even in the existing state of affairs, anything beyond that would be entirely out of the question, and to do even this would consume all of my pemmican, alcohol, and other provisions, which could not be replaced, and would thus destroy every chance of a second attempt next spring. So we regretfully turned our footsteps back to Anniversary Lodge. We had travelled 125 miles north of our camp.

R. E. PEARY.

EXPLORATION IN LABRADOR.—Messrs. Low and Eaton, of the Canada Geological and Natural History, returned in August from a fifteen months' journey in Labrador.

They found the northern part of the peninsula to be a network of streams and lakes. One of the latter, Lake Mickanaw, is more than 100 miles in length and much wider than Lake Mistassini.

Mr. Low reports that the herds of cariboo, on which the Indians of the north depend for subsistence, did not make their appearance in 1893, and that many of the Indians perished by starvation.

It was found that the great iron-bearing formation stretches from Lat. 50° to Ungava Bay and covers an estimated area of 60,000 square miles.

In the spring of 1894, the Hamilton River was ascended, and many photographs of the Great Falls were obtained. The river, which is about as large as the Ottawa, descends about 800 feet in the length of the gorge, and the height of the Great Fall is about 300 feet. The steep sides of the gorge rise from 500 to 800 feet and contract in places below the Falls to 50, and even to 20, feet in width.

At the foot of the Falls Mr. Low found the charred

remains of Cary's* boat and at the top of the cañon the bottle containing the memorial of his expedition.

THE PILOT CHART OF THE NORTH ATLANTIC, for September, says:

A report received from Capt. Pothier, Br. Sch. *Urbain B.*, states that on a voyage from the West Indies to Nova Scotia he fell in with the derelict schooner *Fannie E. Wolston*, July 20, 1894, latitude 30° 16′ N., longitude 66° 26′ W. On boarding the derelict the hull was found to be in good condition; the masts, houses, hatches and bulwarks were gone; the anchors were still on the bows, and the name on the bow and stern still visible.

On August 6 she was again sighted by Capt. Tompsett, Br. S. S. *Merida*, in latitude 34° 05′ N., longitude 67° 20′ W. The current at the time was setting northeast.

Since this derelict was abandoned, October 15, 1891, she has been reported forty-four times. She has been a derelict 1,025 days, during which she has drifted 8,575 miles, and as she is supposed to be afloat yet, her track will probably be still further extended.

There might be, it should seem, a regulation requiring the master of a vessel to take measures for her destruction before abandoning her.

THE GULF STREAM.—The U. S. Hydrographic Office has issued, as Publication No. 110, an article on the Gulf Stream by Lieut.-Commander John E. Pillsbury, U. S. N.

The cause of the Gulf Stream is, he says, directly or indirectly the force of the wind, long continued from the same general direction.

The current from the south-east trade winds divides near Cape St. Roque into two branches, one flowing to the southward along the coast of Brazil, the other toward the West Indies.

The current from the north-east trade winds is

* *Exploration on Grand River, Labrador*, in BULLETIN, A. G. S., No. 1, 1892.

obstructed by the South American coast and the Windward Islands; and the combined currents escape in part through the passages of the Windward Islands, while the remainder passes by the northern side of the West India Islands towards the coast of the United States. The current which enters the Caribbean encounters the coast of Honduras and escapes, part towards the south and part towards the Strait of Yucatan.

Another movement of the water which probably contributes as much to form the Gulf Stream as the surface current due to the friction of the wind, is the water driven to leeward by the break of the waves. Where the wind is blowing in the same direction over a large area, the effect is a simultaneous movement of the surface toward the lee shore.

In the case of the Caribbean, a strong shore current is produced toward the Strait of Yucatan and southward along the Mosquito Coast. It is from this cause that violent shore currents are set up along the coasts of Cape Cod, New Jersey and North Carolina in northeast gales.

The irregularities of the Gulf Stream due to the varying wind can only be predicted in a general way. The force of the current is the result of average conditions, and a temporary abnormally strong wind in the trade region will not materially change the average.

The first part of a norther in the Gulf of Mexico will probably cause a strong Gulf Stream current, because the water is driven toward the Cuban shore, from which it escapes through the Straits of Florida. A wind blowing across the Stream does not change

the position of the current. It simply throws the heated water by the break of the waves and transports it by friction beyond the usual limits, but the current of the Stream holds to its fixed position. The presence of Gulf weed is in no way a sure indication of current, for it is carried more by the waves than by the current. A wind blowing across the Stream may carry every particle of weed into the outside waters. A long continued southerly wind will, by the break of the waves, transport the weed well up toward Nantucket Shoals, 150 or 200 miles from the current of the Stream.

Barometric conditions are a fruitful source of abnormal variations in current in the Straits of Florida, but Lieut.-Commander Pillsbury doubts their effect in the Atlantic.

The average velocity of the current is greatest at the axis, which is rarely in the middle.

It is generally believed that off Cape Hatteras the thermometer is a sure indicator of the Gulf Stream, and that the strongest current coincides with the highest temperature. This, however, is not the fact. The warm water may or may not be accompanied by a current. The warmest water south-east of the Cape is the result of a very gentle flow from the trade region outside of the West India Islands, and the Gulf Stream itself is between this warm water and the 100-fathom curve.

THE GREAT SIBERIAN RAILWAY. (*See map at the end of the* BULLETIN.)—In the *Consular Reports* for July, 1894, Mr. J. M. Crawford, U. S. Consul-General at St. Petersburg, describes the railroad

now in course of construction through the length of Siberia. The first stone of the work was laid by the Cesarewitch, May 12, 1891, at Vladivostok. There are three divisions of the road—the Western Siberian, from Tcheliabinsk to the Ob River (1,328 versts*), together with the middle Siberian section from the Ob to Irkutsk (1,754 versts), and the Vladivostok-Grafskaya section; the second division, comprising the sections from Grafskaya to Khabarovka (347 versts), and from Mysovskaya to Sretensk (1,009 versts); and the third division includes the road round Lake Baikal (292 versts), and the line from Sretensk to Khabarovka (2,000 versts). The total length is 7,112 versts (4,715 miles). From Tcheliabinsk to the Ob the road runs for the most part in a nearly straight line, through a level country. The gradients are not greater than 0.0074 and the curves have a radius of 1,750 feet.

Beyond the Ob the country is hilly, but the gradients are limited to 0.008, and the radii of the curves are 1,750 feet. From Atchinsk, on the Tchulym River, to Irkutsk, a distance of 1,191 versts, the line runs through a mountainous region and crosses the rivers at their summit levels, which are high and narrow, and here the gradients are 0.015, with curves of 1,050 to 1,000 feet. The construction of the roadbed is costly, the embankments being sometimes 70 feet in height. The Yenisei River is crossed on a bridge 3,150 feet in length, and the road then climbs to the summit level along the Berezovka River and the valley of the Sitik. The length of the ascent is 67 versts and in this distance

* 100 versts=66.29 miles.

there are 82 bridges and *pipes.** The mountainous features continue with little interruption to the Irkutsk station, at the 3,065th verst. From Irkutsk the road follows the shore of Lake Baikal for 162 versts to Mysovsk. For part of this distance the line is carried in cuttings along the face of the granite crags and through a tunnel 8,330 feet long across the Zyrkyzunsk chain. From Lake Baikal the road follows and crosses the River Selenga and enters on the Vitimsk plateau; and beyond this climbs a branch of the Yablonovoi Mountains, the water-shed between the basin of the Lena and that of the Amur, and descends past the town of Chita to Sretensk. From this point the continuation is through the valleys of the Shilka and the Amur, and then 400 versts through the valley of the Ussuri, on the border of the Chinese Empire, to the terminus at Vladivostok.

The condition of the work on October 1, 1893, was as follows:

On the section from Tcheliabinsk to Omsk, 80 per cent. of the roadbed was completed, 28 bridges had been constructed, rails laid for 240 versts, and telegraphic communication opened with Omsk. On the second section of the Western Siberian line, all the necessary materials have been prepared, 751,000 cubic feet of earth work handled and three station buildings constructed.

On the middle Siberian section, between the Ob and Krasnoyarsk, final surveys had been made on 300 versts, and the engineers were engaged on the remainder, 833,000 cubic feet of earthwork had been com-

* Probably a mistranslation for *tunnels*.

pleted, 20,000 railway ties had been prepared and 3,375 tons of rails received. According to the Minister of Ways and Communications, the middle Siberian portion of the road will be completed in 1898.

On the Ussuri line telegraphic wires have been laid for 377 versts. The station buildings have been completed and the road bed is nearly finished. Twenty-two locomotives and 368 cars and platform cars have been put on the line, and in November, 1893, 100 versts of the road were opened for traffic; and trains are now running over a distance of 184 versts.

The Transbaikal section will be begun in 1895.

The estimated cost of the work, as published by the Minister of Finance, is:

	Rubles.
For the Tcheliabinsk-Ob Section	47,361,479
" " Ob-Irkutsk Section	73,272,898
" " Irkutsk-Mysovsk Section	22,310,820
" " Mysovsk-Sretensk Section	53,309,763
" " Sretensk-Khabarovka Section	117,555,835
" " Khabarovka-Grafskaya Section	18,737,882
" " Grafskaya-Vladivostok Section	15,661,015
	348,209,692

Errors amounting to 2,000,790 rubles in the figures for the last two sections, as printed in the *Consular Reports*, have been corrected in the addition.

The ruble is the paper ruble, equal to fifty cents, and the cost per mile is 37,020 dollars.

It is officially announced that the road from Tcheliabinsk to Omsk will be opened to traffic on the 15th of October, 1894.

WEST AFRICA AND THE CONGO STATE.—France concluded two treaties in August, one with the Republic of Liberia, the other with the Congo Free State. The treaty with Liberia makes the *thalweg* of the Cavally River the limit of that republic on the east, and bounds it on the north by the parallel, first of 6° 30′, then of 7°, N. Lat., up to the Anglo-French frontier of Sierra Leone.

It is stipulated that, *This line must in every case insure to France the entire basin of the Niger and its tributaries.*

France renounces the rights conferred upon her by ancient treaties to various points on the Grain Coast and recognizes the sovereignty of Liberia over the coast west of the Cavally River.

The Fifth, and last, Article reads:

In recognizing the boundaries now fixed the Government of the French Republic declares that it binds itself only to the free and independent Republic of Liberia, and makes all reservations in case of that independence being impaired or in case of the Republic of Liberia alienating any portion of the territories recognized as hers by the present convention.

The treaty with the Congo Free State provides:

ARTICLE 1. The frontier between the Congo Free State and the Colony of French Congo, after following the *thalweg* of the Ubangi up to the confluence of the Mbomu and of the Welle shall be as follows:—(1) The *thalweg* of the Mbomu up to its source. (2) A straight line joining the watershed between the Congo and Nile basins. From this point the frontier of the Free State is constituted by the said watershed up to its intersection with longitude 30°, E. of Greenwich.

ARTICLE 2. It is understood that France shall exercise, under conditions which shall be determined by a special arrangement, the right of police over the course of the Mbomu, with a right of pursuit on the left bank. This right of police may be exercised on the left bank of the river only in regard to persons caught in the act of trespassing on French territory or on the waters of the river and in proportion as pursuit by the French agents is indispensable to bring about the arrest of the trespassers. France shall have a right of crossing to the left bank to insure her communications along the river.

ARTICLE 3. The posts established by the Free State north of the frontier,

stipulated in the present agreement, shall be handed over to agents accredited by the French authorities as they arrive on the spot.

ARTICLE 4. The Free State binds itself to renounce all occupation and to exercise in the future no political influence west or north of a line thus determined:—Longitude 30° E. of Greenwich (27° 40′ E., Paris), starting from its intersection of the watershed of the Congo and Nile basins, up to the point where it meets the parallel 5° 30′ N., and then along that parallel to the Nile.

This arrangement advances the northern boundary of the Congo State by nearly a degree of latitude and extends the French Congo directly through the Sudan to the Nile.

The Congo State gives up the Bahr-el-Ghazal region, leased to it by England, which had already relinquished in deference to Germany the 25-kilometre strip between Lakes Tanganika and Albert Edward; so that the Anglo-Congolese convention of May 12, 1894, is now a dead letter.

EMIN PASHA'S MURDERERS.—According to the London *Times* of July 17, Baron Dhanis, in a letter written from the Congo, reports the capture of Ismaila Mamba and Gaonga, and their trial by a court-martial, which found them guilty of the murder of Emin Pasha. Piani Kitma and N'Tambwe, charged with conniving at the murder, were also in custody, and with them the Arab chief Mserera and his son, who are accused of killing Lieut. Michiels and Major Hodister.

The subsequent proceedings have not been reported.

THE NILE RESERVOIR.—At the Seventh Ordinary General Meeting of the Egypt Exploration Fund, held May 23, 1894, the President, Sir John Fowler, spoke

on the subject of the proposed reservoir in the valley of the Nile.

The various schemes proposed were mentioned in order, beginning in the North with that of Mr. Cope Whitehouse for the utilization of the Wady Raian, the extensive depression in the desert immediately south of the Fayum, and consequently near the site of the ancient Mœris. To give practical effect to this suggestion, the President said, it would be necessary to provide a large ingress canal from the Nile, and an equally large egress canal, so that flood waters might flow into the Wady Raian and irrigation waters be drawn off from it; and it would also be necessary to construct an extensive dam across the entrance to the Wady.

This scheme avoided a dam across the river and interference with antiquities; but the estimated cost of the works and the annual expense of dredging and maintaining the canals, left no alternative but to decide against it. Furthermore, the area of land to be improved by this plan, if adopted, was, in the words of Sir John, "the least of all the schemes."

The scheme next in order was that of a dam or barrage across the Nile at Silsilis. At this point the bed of the river consists of a very soft sandstone rock, with beds of clay; and the Commissioners unanimously rejected this plan.

Two sites available for a dam were found at the First Cataract: one to the south of the island of Philæ, at Kalabshe, where the rock is strong and good, and the dam would not interfere with the island, though the work would be costly; the other, to the north of

Philæ, and suitable in every way but one, and that one should condemn it. If the dam were established at this point, the waters would entirely overwhelm the island of Philæ. After stating these facts, Sir John Fowler adds:

> It is not surprising, under these circumstances, that a majority of the Commissioners rejected all other alternatives, and adopted Philæ as a site; and so far I agree with them.

Sir John is, perhaps, not easily surprised, but he seems to have felt compunctious visitings about the contemplated destruction, for on the 11th of July he wrote to the Secretary of State for Foreign Affairs to express the solicitude of the Egypt Exploration Fund for the antiquities of Egypt, as of priceless value in the history of the world.

It is not to be supposed that representations or protests will have any great weight with the authorities who have the matter of the reservoir in hand. Governments are not to be reached; and between the British Government, which does not appear, and the Egyptian Government, which is the shadow of a name, there is no one to bear the responsibility of wrong-doing in Egypt.

A storage reservoir for the flood waters of the Nile is declared to be a necessity for the development of Egyptian agriculture and the greater comfort of the people; but it is not said what is to become of the 30,000 peasants whose homes are to be involved in a common ruin with the temples of Philæ.

Mr. Cope Whitehouse, but for whom there would be no Nile reservoir, does not accept the view of the Wady Raian project taken by the Commissioners and

by Sir John Fowler. He declares that no reservoir is required for Upper Egypt, the low-Nile daily flow at the cataracts of Assuan being 30,000,000 cubic metres. The total amount required to give Upper Egypt all that it longs for but may not touch, to maintain existing areas in the Delta and extend cultivation to the coast-line and the Menzaleh bank of the Suez Canal, is only 3,600 million cubic metres. It is in the neck above the Delta that the drainage-canal and flood-escape are needed.

As to the cost of the Wady Raian project, Mr. Whitehouse, in his calculation furnished to the Foreign Office in 1887, estimated it at about £1,000,000. In 1890 he repeated this approximate calculation; but Lord Cromer, in 1891 and 1892, puts the cost at £1,500,000. Even this estimate is £500,000 below that of the proposed reservoir at Assuan.

At the sitting of the Technical Commission, held on the 27th of March, Mr. Whitehouse was asked to explain his project. This he did, and the result is set forth in an article in *Engineering*, of June 15, 1894, as follows:

> Mr. Cope Whitehouse . . . . concluded by asking the Commission to reject the Raiyan project, prepared by Mr. Willcocks, as wholly impracticable. M. Boulé and M. Torricelli thereupon remarked that "the project of Mr. Cope Whitehouse was entirely different from that which had been submitted to the Commission, and that before passing upon it it would be necessary to study it and prepare estimates of its cost." This was not done. The objections of the Commissioners are now stated to be three in number. . . . . Taking the objections in order, they are:
>
> 1. The cost of the plan proposed by Mr. Willcocks. This is put at 3,700,000*l.*, against Colonel Western's estimate of 827,000*l.*; and Mr. Willcocks' own previous estimate of 1,479,247*l.* The discrepancy in the figures given by the Public Works Ministry at different times is bewildering. In his notes on the Wadi Raiyan scheme of December, 1888, Sir C. Scott Moncrieff said that in the previous April he had submitted to the Council of Ministers a note "summing up

the results of Colonel Western's careful survey and study of Mr. Cope Whitehouse's Wadi Raiyan project. Since then we have received no fresh information on the subject, except that there seems a likelihood of the rock in the great cutting into the valley being softer than Colonel Western anticipated." . . . .

2. The Commissioners object to the Wadi Raiyan because it will only supply Lower Egypt. But it is clear that as long as the Nile furnishes a minimum of 25,000,000 cubic metres daily at Assouan, and the total maximum consumption of water possible above the Raiyan reservoir is only 11,600,000 cubic metres, no reservoir is required for Upper Egypt. This point appeared to be settled beyond all further discussion by Major Brown in his work (page 107), which was recognized as an official publication and a standard authority on the subject.* . . . .

3. The Technical Commission also decided that the reservoir would be a menace to the lower part of the Fayoum, and might cause dangerous springs through (possible) fissures in the limestone rock. No such possibility was considered as within the range of reasonable probability by the Public Works Ministry from 1886 to 1894. Major Brown's excellent treatise was largely written to show that the Fayoum had been a vast lake for thousands of years, and that the water, under a pressure of over 200 ft., had never passed into the Raiyan depression. In modern times, with a difference of 35 ft., there has been no percolation.

What with official obstruction and official arithmetic, one thing appears to be settled: there will be no reservoir in the Wady Raian.

There will be delay in adopting a plan for a storage reservoir, but the one finally chosen will, undoubtedly, be that which is condemned by the right sentiment of the civilized world.

The men in power, who declared that in 1890, for the first time in history, forced labour had ceased, and was thenceforth abolished in Egypt, and confessed in 1894 that they had profited in the previous year by the forced, unpaid labor of 53,000 peasants, will destroy without a pang the resting-place of Him who sleeps in Philæ.

* The Fayûm and Lake Moeris, by Maj. R. H. Brown. 4to. London, 1892.

THE ROYAL SOCIETY OF NEW SOUTH WALES offers its Medal and £25 for the best communication (provided it be of sufficient merit) containing the results of original research or observation upon each of the following subjects:

Series XIV.—To be sent in not later than 1st May, 1895.

No. 46.—On the Silver Ore Deposits of New South Wales.

47.—On the Physiological Action of the Poison of any Australian Snake, Spider, or Tick.

48.—On the Chemistry of the Australian Gums and Resins.

Series XV.—To be sent in not later than 1st May, 1896.

No. 49.—On the Origin of Multiple Hydatids in Man.

50.—On the Occurrence of Precious Stones in New South Wales, with a description of the Deposits in which they are found.

51.—On the Effect of the Australian Climate on the Physical Development of the Australian-born Population.

The competition is in no way confined to members of the Society, nor to residents in Australia, but is open to all without any restriction whatever, excepting that a prize will not be awarded to a member of the Council for the time being; neither will an award be made for a mere compilation, however meritorious in its way. The communication, to be successful, must be either wholly or in part the result of original observation or research on the part of the contributor.

The Society is fully sensible that the money value of the prize will not repay an investigator for the expenditure of his time and labour, but it is hoped that the honour will be regarded as a sufficient inducement and reward.

The successful papers will be published in the Society's Annual Volume. Fifty reprint copies will be furnished to the author free of expense.

Competitors are requested to write upon foolscap paper—on one side only. A motto must be used instead of the writer's name, and each paper must be accompanied by a sealed envelope bearing the motto outside, and containing the writer's name and address inside.

All communications to be addressed to the Honorary Secretaries.

T. W. E. David,
J. H. Maiden,
Hon. Secs.

The Society's House,
5 Elizabeth Street,
Sydney, 13th December, 1893.

WASHINGTON LETTER.

WASHINGTON, September 29, 1894.

Without derogating in the least degree from the services of the two eminent scientists who preceded Secretary Langley, it is perfectly apparent to those who are at all familiar with the management of the Smithsonian Institution that the present methods and lines of administration are vastly superior to those that have formerly prevailed. This is due partially at least to the increased income from the invested funds of the Institution, but probably in a greater degree to the efficiency of carefully selected assistants who reflect accurately and promptly the plans and purposes of the Secretary.

The funds of the Institution which are devoted to the "diffusion of knowledge" are by no means confined to the agency of the printing press, but grants of money are frequently made to aid original investigators. In 1893 Prof. E. W. Morley was provided with special apparatus at the expense of the Institution to continue his determinations of the density of oxygen and hydrogen. A grant of $500 was made to Dr. O. Lummer and Dr. E. Pringsheim of Berlin for researches on the determination of an exact measure of the cooling of gases while expanding, with a view to revising the value of that most important constant which is technically termed the "gamma" function. A second grant of

$1,000 was made to Dr. J. S. Billings and Dr. Weir Mitchell for an investigation into the nature of the peculiar substances of organic origin contained in the air expired by human beings, with a specific reference to the practical application of the results obtained to the problem of ventilation for inhabited rooms. An annual grant of $500 for three years was made for the use of a study table in the laboratory of the Zoological Station at Naples for American biologists. Prizes or premiums of $10,000, $2,000, $1,000 and a gold medal, accompanied by a duplicate impression in silver and bronze, were offered for treatises embodying some new and important discovery in regard to the nature or properties of atmospheric air in various specified relationships. A very large number of papers have been received in response to these offers, including some very distinguished names, from all parts of the world.

For the first time in many years the annual reports of this Institution are printed up to date. The report for 1893 contains a number of papers of unusual interest. Several important publications are now going through the press, or in course of preparation; among others, Mr. W. W. Rockhill's narrative of his travels in Tibet and Mongolia in 1891–'92. Mr. Rockhill travelled extensively in this region under the auspices of the Smithsonian Institution, and his explorations have added much to our knowledge of the country. A portion of the collection of objects he has made will eventually be placed in the National Museum. Other publications promised at an early date are Smithsonian Geographical Tables, by R. S. Woodward; Physical Tables, by Thomas Gray,—companion volumes to the

Meteorological Tables already issued,—Varieties of the Human Species, by Giuseppe Sergi, translated by D. G. Brinton; Index to the genera and species of the Foraminifera, by Charles Davies Sherborn, Part 2; Index to the literature of Didymium, by A. C. Langmuir; Index to the literature of Lanthanum, by W. H. Magee; Index to the literature of Cerium, by W. H. Magee; Bibliography of Aceto-Acetic Ester, by Prof. P. H. Seymour.

The Bureau of Ethnology has recently published [Contributions to North American Ethnology, Vol. IX.] The Dakota Grammar, Texts and Ethnography, prepared by the late Dr. S. R. Riggs.

The author, who died in 1883, had for nearly fifty years associated this work with actual residence among the Dakota Indians. The manuscript which he left required some editing before printing, and to this task the Director of the Bureau assigned the Rev. James Owen Dorsey. Mr. Dorsey has included additional investigations among the Dakota and other tribes of the Siouan stock since the death of the author, and in a Preface of 32 pages contributes several valuable ethnographic notes.

Mr. Dorsey commenced mission work among the Ponka Indians in 1871, in the southern part of the region then called Dakota Territory. His work was continued for two years, when it was interrupted by illness. In 1878 he repaired to the Omaha reservation, in Nebraska. On the organization of the Bureau of Ethnology, in 1879, he was formally attached to it, and has since been continuously occupied in researches relating to the languages, institutions and beliefs of

the Indians of the interior, chiefly those of the Siouan and Athapascan stocks. He has become one of the foremost living students of our aboriginal languages.*

The eleventh and twelfth annual reports of the Bureau of Ethnology have appeared almost simultaneously, and more than sustain the excellent reputation of the work of this Bureau of the Smithsonian Institution. Three original contributions accompany the eleventh report, and one contribution the twelfth report. All treat of the habits and customs, beliefs and institutions of our native races. The first paper (relating to the pueblo of Sia) has an unusual history.

The researches were commenced by the late Col. James Stevenson in 1879, and continued during 1887–'88 (his last year of field duty), when his work was interrupted by failing health and his subsequent much-lamented death. He left copious notes, photographs and sketches, but these were not reduced to a form adapted to publication. His widow (Mrs. Matilda Coxe Stevenson) undertook the digestion and arrangement of the notes for the press. She made another visit to the field, and, with indefatigable energy, carried the work to completion.

The single contribution contained in the twelfth report is an exhaustive study on mound explorations, by Cyrus Thomas. The conclusions reached are: (1) That nothing found in the 2,000 mounds examined justifies the opinion that they are uniformly of great antiquity. (2) That the links of evidence connecting the Indians and mound-builders are so numerous and

* Major Powell, in Eleventh Annual Report of the Bureau of Ethnology.

well established as to justify archæologists in concluding that they were one and the same people.

In view of the evidences presented in this report (far too voluminous to discuss here), the theory that the makers of these ancient tumuli of the eastern half of the United States are the remains of a people more highly cultured than the tribes found by the white man, and who vanished from the country anterior to the Columbian discovery, must be abandoned. The theory of the "lost races" has always been the most popular one, and found advocates in Barton, Harris, Short, Wilson, Dawson, Morgan, Squier and Davis; while the "Indian" theory has been maintained by Schoolcraft, Gallatin, Cass, Lubbock, Drake, Carr, M. F. Force, Thruston, McCulloh, Dall, Powell and Thomas.

A few changes have been made among the higher officials of the National Museum. Mr. Frederick W. True is now executive curator, instead of curator-in-charge. Mr. A. Howard Clark has been transferred from the Museum to the office of Secretary Langley in order to prepare for publication a considerable accumulation of important papers. Mr. R. Edward Earll takes Mr. Clark's place as curator of historical relics and editor of the National Museum publications. The Museum now contains about 3,500,000 specimens. The relations between the Smithsonian Institution and the National Museum are intimate, but it should always be remembered that the Institution is an entirely distinct and separate body, and sustained by its own invested funds. The National Museum, the Bureau of Ethnology, the Zoological Park and the Astrophysical Observatory have been placed by Congress under the super-

vision of the Institution, but all three are supported by Congressional appropriations amounting for the current year to the sum of $269,100.

Mr. Frank H. Cushing is arranging in one of the large halls of the Museum a very large and complete collection of material pertaining to the history of the Pueblos and the allied tribes. Mr. Cushing, by means of his long years of residence among the Pueblos, is better qualified than any other man living to take charge of such a task. Professor Mason says that the Pueblo collection in the Museum is the richest of any people or race; in fact, one of the greatest ethnological collections in the world, and it is proposed to put it together for display and study. Mr. Cushing expects to carry the tribal history back 700 years before the invasion of the Spaniards.

THE STATE DEPARTMENT'S HISTORICAL MANUSCRIPTS.—The latest Bulletin (No. 4) of the Bureau of Rolls, Department of State, contains a calendar of the correspondence of James Madison, preceded by a chronological record of Madison's life. It is a fine imperial 8vo volume of 739 pages, prepared by Mr. Walter Manton. The collection of letters (about 8,000) is alphabetized under the names of the parties addressed in the case of letters *from* Madison, and under the names of the writers in the case of letters *to* Madison. Following each name is a brief of the letter. This class of Bureau work, so well begun with the Monroe and Madison calendars, should be prosecuted as expeditiously as possible, until we have calendars of Washington,

Franklin, Jefferson and Hamilton, the Continental papers, etc., etc.

The difficulty experienced by those who would consult the historical papers of the State Department is that they neither know what the Department contains, nor precisely, therefore, what they themselves want; and as confidence in human nature has not yet reached that state of sublime perfection which would unlock the doors and say to the inquirer, "Help yourself," the imperative demand for calendars, either in print or otherwise, is apparent. The wonder is that for such a very long period the Department has been without them. That numerous complaints have arisen because of the lack of such facilities goes without saying. In the absence of the authority of Congress to print *verbatim*, etc., the entire collection of manuscripts, let us have calendars or indexes, or both, in print or otherwise, as rapidly as possible.

At the last session of Congress, Senator Mills offered an amendment to the Sundry Civil bill, appropriating $25,000 for printing the Revolutionary archives in the Department of State. The amendment was referred to the Library Committee, which reported favorably, but reduced the amount to $10,000. The House of Representatives not agreeing to the proposition, the matter went to the Conference Committee of the two Houses, along with other subjects of disagreement. It emerged in the following form:

"The Secretary of State is hereby directed to cause the Revolutionary archives, except the military records, now deposited in his Department, to be carefully examined, and to ascertain what portions are of sufficient

and historical value to publish, and the number of printed volumes they would make, and the reasonable cost of their publication and editing, and report the result to Congress, with such recommendations as he may deem proper."

But in another part of the same act appears the following clause:

"That all military records, such as muster and pay rolls, orders and reports relating to the personnel or the operations of the armies of the Revolutionary War and of the War of 1812, now in any of the Executive Departments, shall be transferred to the Secretary of War, to be preserved, indexed and prepared for publication."

When this clause was under consideration in the Senate, Senator Hoar—the historical authority of that body—moved to strike out the words "military records, such as," and his amendment was agreed to. He also proposed another amendment, viz.: "*Provided*, That whenever the head of any Department shall deem the retention of any such records in his Department essential to the convenient transaction of the business thereof, he may direct *copies* of such records to be transmitted to the War Department." And the amendment was agreed to. Nevertheless, when the bill emerged from the Conference Committee and was finally passed and printed, it was found, to the surprise of many, to be in the form first above mentioned.

Senator Hoar, in urging his amendment, stated clearly his reasons. He said: "A great many of the military records which are in the State Department have come from the private papers of distinguished

officers, or other persons in public life, military or civil, during the Revolutionary War; muster rolls have come from the custody of the regimental and other officers to whom the reports were made. They are connected very often with family papers which have been purchased by the Government or given to the Government. A great many of them are inextricably connected with other documents and ought not to be separated. It is quite important that where these papers are connected with others, or are needed for the service of the different Departments, *copies* shall be sent, not the originals."

As the matter stands now, the Secretary of State, for instance, is *directed* to transfer all "military records" to the War Department, *i. e.*, to the Record and Pensions Division, C. F. Ainsworth in charge. And it means the spoliation of the most valuable historical manuscripts of the Department. What are the originals of the Proceedings of the Continental Congress, or the military papers of Washington and other generals of the Revolution, if they are not "military records" of the "operations of the armies of the Revolutionary War"? These manuscripts comprise hundreds of volumes of the priceless collections in the Department of State. Separated from other manuscripts of the same period, which are not "military," but historical records, the continuity of the papers would be destroyed for historical research, and the public for all time to come would be put to great inconvenience and annoyance. The last clause of the scheme—"prepared for publication"—is a mere ruse. Every Historical Society, every historian and every

patriotic citizen should protest vehemently and with great indignation against the perpetration of this scheme, and respectfully request the Secretary of State to defer action until an expression from Congress can be obtained. It seems very remarkable that after the forcible exposition of the matter by Senator Hoar and the adoption of his amendment without opposition, the bill should finally emerge from the dark chambers of the Conference Committee with every objectionable feature restored and made mandatory besides. There must have been a considerable amount of jugglery with that Conference Committee, because Congress, as a body, cares as little about matters of this kind as would the man in the moon.

NEW GEOGRAPHY.—The northeast corner of Utah, named by travellers "the treasure vault of Utah," has long been segregated as a reservation for the Uncompahgre and Uintah Indians. The reservation contains about 4,000,000 acres—an area about four-fifths the size of Massachusetts. Under legislation procured at the last session of Congress this region is to be restored to the public domain and made subject to entry under the homestead and mineral laws of the United States.

About 60 per cent. of the tract is available for agricultural and grazing purposes; but it is said that the mining possibilities of the country outweigh its agricultural attractions, which are of very high rank.

The region is encircled by the Uintah, the Wasatch and the White River Mountains. The Uintah Mountains are described as particularly rugged and picturesque. They are part of the great range that runs

north and south through Utah into Idaho and Wyoming. The climate is about the same as that of the Salt Lake basin, and there is an abundant supply of water.

When the Presidential proclamation declares these lands open to settlement we shall witness the wild scenes of the Oklahoma and Cherokee Strip opening.

Under recent legislation, also, an agreement has been made with the Yankton tribe of Sioux or Dakota Indians in the Yankton reservation in South Dakota to surrender to the United States a portion of their land,—about 300,000 acres; and with the Alsea and other Indians on Siletz reservation in Oregon,—about 60,000 acres; and with the Nez Perce Indians upon the Lapwai reservation in Idaho for some 500,000 acres more,—in all about 900,000 acres are to be restored to the public domain.

The Indian reservations are fast disappearing from the map of the United States.

IT WILL INTEREST THOSE WHO STUDY NEW GEOGRAPHIC FEATURES IN SOUTH AMERICA to learn that Mr. Juan José Castro, who is Minister of Public Works for Uruguay, has prepared a treatise on South American railways and the great international lines. It supplies a mass of valuable information concerning the workings of South American railways, as well as of enterprises either in process of development or merely projected.

Señor Castro says that the two great projects which may be said to dominate the railroad development of South America are the proposed Intercontinental Railway and the South American Interoceanic Railway.

The object of the first named line is to establish direct communication between North and South America from Canada to the River Plate and Chile. The surveys for this purpose have been going on for some time under the direction of the Intercontinental Railway Commission, with headquarters at Washington. The second, or Interoceanic Line, is intended to shorten the time required for communication between the Pacific Ocean, the River Plate and Brazil and the European continent, and, of course, to open up new facilities for commerce.

A synopsis of this book of over 650 pages is given in the February Bulletin of the Bureau of American Republics.

Mr. P. de Murguiondo, Consul-General of Uruguay, will furnish copies of the work to those specially interested upon application at 309 East North Avenue, Baltimore, Md.

A new steamship line is in operation between New Orleans and Cartagena (Colombia). The vessels leave New Orleans on the 10th, 20th and 30th of each month and reach Cartagena in six days, making the quickest and most frequent communication with the United States that has yet been available. The mail service between the two countries has been perceptibly stimulated.

A railroad built by Americans, running from Cartagena southward to Calamar on the Magdalena River has been opened for traffic. It is expected to revive the commercial importance of Cartagena.

An Anglo-Dutch syndicate has put a surveying party in the field looking for the most feasible route for a

railroad to connect Guatemala City with the Tehuantepec railway.

BOUNDARIES.—The resurvey and erection of monuments on the boundary line between the United States and Mexico, that is to say, the line for about seven hundred miles from El Paso to the Pacific, has been completed. Many of the original monuments had disappeared. In one locality none were found for more than one hundred miles, and in another a monument was found a mile south of the true American line, and the mile strip extended for a distance of thirty-two miles along the supposed boundary, considerably mixing up the *loci habitandi* of both Americans and Mexicans.

The entire preliminary survey of the line between Alaska and the British possessions has been completed and the parties of the United States Coast and Geodetic Survey have returned. Few people can estimate or appreciate the hard work and rough experiences connected with such an undertaking,—the frequent swamping and upsetting of boats in surfs or swift currents,—the loss of provisions, clothing and cooking utensils,—the unfriendliness of native tribes,—the fatigue from travel over an unexplored and very rugged country. Nevertheless it is stated that in the six years this survey has been in operation, not a single life has been lost.

The popular and scientific value of the work will be very much enhanced by the numerous photographs obtained, as well as the accretion of natural specimens. Mr. McGrath's latest observations confirm his previous

determinations of the height of Mt. Logan (19,500 feet), so that this triple-headed giant mountain overlaps St. Elias by some 1,500 feet. But the great range has not yet been fully explored.

With the data now at hand the Commissioners, in case of agreement, can lay down the boundary line. The value of the region in dispute depends largely upon such mineral wealth as may be developed in the future.

ALASKA.—It is reported that a party of Lapland emigrants secured through the intervention of the U. S. Bureau of Education has arrived at Alaska. The object of this importation is to familiarize the natives with the use and care of reindeer, a few hundred of which, partly by means contributed by benevolent people and partly by Government aid, have been transported from Siberia in order to increase the diminishing food supply of the natives. It is expected that the introduction of this colony will attract other Lapps to the region.

Mr. Miner W. Bruce, in a report made recently by Dr. Sheldon Jackson, general agent of education in Alaska, has a most interesting and original chapter on some of the habits and customs of the Eskimo.

A convention has been called to meet at Juneau, November 5th, for the purpose of considering the need of a code of laws for the government of the vast domain of Alaska, and the necessity for the establishment of a mail route into the Yukon country, by way of Chilcat pass; and other remedial legislation by Congress.

Congress at its last session made provision for col-

lecting and printing the decisions of the United States District Court of Alaska!.

IMPORTANT PROJECTS.—Three highly important projects were perfected by Congress at the last session. First, the construction and equipment of a boat railway from the foot of the Dalles Rapids to the head of Celilo Falls on the Columbia River. This project contemplates an hydraulic lift to raise steamboats out of the water, placing them upon a large tramway car running upon eight or more tracks, transporting them thirteen miles and returning them to the water. It is expected that this gigantic railway and necessary machinery will be completed in four years, at a cost of about $2,000,000. The work will be under the supervision of the Chief of Engineers, U. S. A. An elaborate report on the subject, accompanied with drawings, was made by this officer at the first session of the present Congress. The contemplated improvement will be of immense value to the great region in Oregon and Washington drained by the Columbia River.

Second, for enlarging the waterway which connects Puget Sound with Lakes Union and Washington, that is to say, to convert this passage into a ship canal with the necessary locks and appliances. The plan contemplates dredging Salmon Bay on Puget Sound, so as to give ships an opportunity to ascend by the canal and anchor in fresh water. Also to have a naval station in fresh water for vessels not in commission.

Third, for a dam and lock in the rapids of the Mississippi River, between Saint Paul and Minneapolis,

and so extend navigation from Saint Paul to the great flour mills at Minneapolis.

Compared with the schemes for "improving" creeks and small lakes—most of these too insignificant for mapping—with which Congressmen attempt (often with success) to burden River and Harbor Bills, these three projects are giants, and far-reaching in benefits.

Congress has also directed a survey for the location of a canal connecting Lake Superior and the Mississippi River, either by way of the Saint Croix, Rum or Upper Mississippi Rivers.

Also, a survey of the Miami and Erie Canal, the Ohio Canal and such branches and such river and stream channels as may form available portions of a continuous canal to connect Lake Erie with the Ohio River.

NEW NAVAL OBSERVATORY.—Prof. William Harkness, the eminent astronomer, has been placed in full charge of all the astronomical work of the Naval Observatory. His hands are not tied by detailed regulations, it being the intention of the authorities to give him power adequate to his responsibilities.

Heretofore the astronomical work of the Observatory has been conducted under the direction of naval officers, and among these have been Capt. Charles Wilkes, Lieut. J. M. Gilliss, Commander M. F. Maury, Admiral C. H. Davis, Rear Admiral B. F. Sands. But the scientists of the country have long contended that naval officers, by reason of their education principally in other directions, were not competent to direct astronomical work, and that therefore the astronomical researches

made at the Observatory have not conformed to any regular system; that observers were left to follow largely their own individual inclinations, and their own ideas of what the interest of science demanded without any proper correlation of the work.

Under the reorganization the Observatory proper continues in charge of a naval officer who is charged with the general superintendence and government of the Observatory. All the astronomical work and instruments are under the absolute control and direction of the chief astronomer, who will report directly to the Navy Department instead of transmitting the work to the naval officer on duty as superintendent of the Observatory.

Although the contention for this change has been going on for many years, to Secretary Herbert belongs the distinguished merit of having made an unqualified and just decision.

The Naval Observatory was established in 1842, and prior to its recent removal to the most commodious and completely equipped buildings in the world, occupied a commanding site at the foot of 24th Street, originally known as Peters' Hill from its proprietor. A portion of Braddock's army camped on the spot in 1755, and on the bank of the Potomac is the rock known as Braddock's rock, where the troops landed. Later, it was proposed to erect a fort here. It was a plan of Washington to establish a national university on the spot, and the grounds came to be known as University Square. In 1813–14 a part of the American army encamped on the hill and advanced to Bladensburg.

SCULPTURE.—The plan of the reading room of the new Library of Congress contemplates the introduction of sixteen statues to illustrate the several forms of literary art. Statuary forms of the following named ancient and modern famous men have been selected to represent the subjects named:

Poetry—Homer and Shakespeare.
Art—Michael Angelo and Beethoven.
Science—Newton and Henry.
History—Herodotus and Gibbon.
Philosophy—Plato and Bacon.
Commerce—Columbus and Fulton.
Law—Solon and Blackstone.
Religion—Moses and St. Paul.

But certain other philosophers, poets and essayists are not "left in the cold," even though the niches for their busts are outside the building. These subjects for continued fame are Franklin, Demosthenes, Dante, Irving, Macaulay, Sir Walter Scott, Emerson, Hawthorne and Goethe.

The names of the gentlemen in charge of the productions of these works of art are sufficient guarantee that none of the atrocities already perpetrated in the "Statuary Hall" of the Capitol will be repeated.

It is understood that a dozen or more statues which the late Mr. Corcoran caused to be manufactured, and placed in niches outside the "Corcoran Art Gallery," will be sold to the best bidder or given away when the new Gallery now being erected is occupied.

The National Sculpture Society offers prizes of $300 and $200 for the best and second best designs for a

new dollar, the competition to be held in 1895. It may be asked, what authority the National Sculpture Society has in the matter. None whatever; but if a satisfactory design should be submitted, the Treasury Department might be very glad to adopt it. Before the unsatisfactory designs of the present subsidiary coins were adopted, there was an open-to-all-the-world competition; but it is said that artists held aloof. At all events, the designs which poured in were so unacceptable that the regular engraver of the mint was directed to, and did, make the designs for the 50-cent, 25-cent and 10-cent pieces.

Financial Legislation of the 53d Congress.— Besides the repeal of the purchasing-bullion clause of the Sherman Act, and the passing of the bill requiring the coinage of seigniorage, which received the presidential veto, the only other financial legislation accomplished is the act to subject to State taxation national bank notes and United States treasury notes. The bill was approved by the House Committee on Banking and Currency by a majority of one, Mr. Walker of Massachusetts voting with the democrats for it, and Mr. Springer and Mr. Johnson of Ohio with the republicans against it. There was not a full House when it passed, but the vote was 173 to 41. It passed the Senate without division. The act provides that the national bank bills and United States legal tender notes and other notes and certificates of the United States, payable on demand, and circulated as currency, shall not be exempt from taxation under the laws of any State or Territory, provided, that taxation is exer-

cised at the same rate and in the same manner as upon other property or money.

Prior to the passage of this act there were about $500,000,000 of United States notes, including $150,000,000 of the notes for the purchase of bullion issued under the Act of 1890, recently repealed, exempt from taxation. Some of the greenback issue ($346,000,000) has been lost or destroyed, and a very large amount of the $500,000,000 has been withdrawn from circulation and hoarded by banks and individuals on account of its non-taxable feature. Under the new act all forms of United States paper currency may be taxed the same as gold and silver.

Prominent Changes in the Government Service. —In the Coast Survey, Professor Mendenhall resigned the position of Superintendent in July last, and went to Europe. The unfriendly attitude of the Treasury Department (of which the Coast Survey is an attachment) in impeding the work of the bureau for the purpose of forcing his retirement, and in removing experienced and valuable assistants in order to make room for political spoilsmen, and persistent malignment by a few men in Congress, rendered his position simply unbearable. He is now President of the Worcester Polytechnic Institute, and the Government has lost the services of a gentleman of the highest scientific attainments and spotless character. His successor is William W. Duffield, a gentleman who has had successful experience in constructing railroads. For the three months following Prof. Mendenhall's resignation, Mr. W. A. Pugh, Commissioner

of Customs, an office abolished by the Dockery commission (so called), acted as superintendent, but it was gossiped around the city that the janitor of the building and Mr. Logan Carlisle (son of the secretary of the treasury) were "running" the office.

In the Geological Survey Major Powell, who organized, and for thirteen years carried on one of the best geological institutions in the world, has retired, and now devotes his entire time to the Bureau of Ethnology of which he is the Director. He has a vast amount of ethnographic material, the accumulations of more than a quarter of a century, which he will arrange for publication.

The successor of Major Powell in the Geological Survey is Professor Charles D. Walcott, a paleontologist and geologist and in every way qualified for such a prominent and responsible position. Professors S. F. Emmons and George F. Becker have also become reidentified with the Survey as geologists.

The office of editor-in-chief of the Survey has been abolished by order of the Secretary of the Interior, and so the Government loses the services of Dr. W. A. Croffut, an accomplished specialist and a gentleman of broad general information.

In the Treasury Department the offices of Commissioner of Customs, Deputy Commissioner of Customs, Deputy First Comptroller, Second Comptroller, and Deputy Second Comptroller have been abolished. The First Comptroller will hereafter be known as Comptroller of the Treasury, and there will be an Assistant Comptroller. The duties of the office of

Commissioner of Customs are transferred to the Comptroller's office.

The titles of First Auditor, Second Auditor, Third Auditor, etc., are abolished and in lieu thereof the First Auditor will be known as Auditor for the Treasury Department; the Second Auditor as Auditor for the War Department; the Third Auditor as Auditor for the Interior Department; The Fourth Auditor as Auditor for the Navy Department; the Fifth Auditor as Auditor for the State and all other departments or bureaus not specifically provided for; the Sixth Auditor as Auditor for the Post-Office Department. The Division of Warrants, Estimates and Appropriations will hereafter be known as the Division of Bookkeeping and Warrants.

LAKE NAVIGATORS SHOULD HEED THE STORM SIGNALS OF THE WEATHER BUREAU.—Prof. Harrington gives in detail the number of wrecks occurring on the Great Lakes* from December 17, 1885, to November 15, 1893, involving a loss of $4,951,099 and 420 lives. It is but fair to assume that a large proportion of both lives and property might have been saved had the weather conditions been known and studied in advance of the storms. In a number of cases the vessels had been away from shelter but a short time. A chart which accompanies Prof. Harrington's report gives the location of 227 wrecks. In 1892 and 1893, when weather signals were available, there were but ten wrecks, and seven of these occurred during stormy conditions of which timely warning had been given by the Weather

* Report of wrecks which occurred on the great lakes from 1885 to 1893.

Bureau. The time is not distant when it will be made a criminal offence for the master or owner of a vessel to put to sea despite the official warnings as to dangerous weather conditions.

NECROLOGY.—The late Dr. James C. Welling was probably the best known and most valued citizen of Washington. He gave vigor to the life of the federal city during the period of its greatest growth, and impressed his personality strongly upon this community. He was one of the best of historical scholars, an excellent classical scholar, and a notable legal scholar; while few could surpass him in brilliant and forcible use of the English language. Witness the editorial columns of the great *National Intelligencer* from 1850 to 1865.

The points of his greatest activity in Washington were the Columbian University, of which he was President, and whose scholarship attendance he raised from 500 to 960; the Smithsonian Institution, of which he had been a Regent and member of the executive committee for many years; the Corcoran Art Gallery, of which he was President of the Board of Trustees, and a highly valued friend of the founder; and St. Elizabeth's Asylum for the Insane. At the same time he participated actively in the discussions of the National Geographic Society, the Anthropological Society and the Philosophical Society. He was also a member of the Washington Monument Society, and President of the Copyright League of the District. He was honored by many institutions of learning with degrees, and had membership in many literary, scientific and historical societies outside this city.

He was a close friend of Lincoln, Seward and Grant; and his collection of papers bearing upon the war period is probably unsurpassed. At the time of his death he was making preparations to enter upon the work of writing a history of the war in its civil, political and judicial aspects.

The passing of this accomplished scholar is a calamity to this community.

Major Thomas Turtle, recently deceased, was one of the most efficient members of the Engineer Corps of the Army. He was a gentleman of high attainments, and was greatly valued for his ability and wide experience. During his connection with the service he has been stationed in nearly every section of the country, and his genial disposition and modesty made for him friends almost innumerable. Since 1887 he has been stationed here, in charge of one of the divisions of the Office of Chief of Engineers, and it is not risking anything to say that he was the most affable officer among General Casey's assistants.

Major Turtle was a member of the National Geographic Society, and represented the War Department on the U. S. Board on Geographic Names.

Robert Stanton Avery, who died recently in this city, left a portion of his large estate to the Smithsonian Institution. Mr. Avery died at the age of 86. He was a graduate of Harvard College, and prepared for the ministry. He taught school for a while. In 1853 he was appointed by Prof. Bache to a position in the Coast Survey Office, and in 1866 was made chief of the Tidal Division. He resigned in 1887, since which

time he has led somewhat of a secluded life; but he was a student to the very last.

His published works are:

Mode of forming a brief Tide Table for a chart, 1868.

Tabular statement of results of computed Tide Tables for charts of the Western Coast of the United States, 1870.

Mode of forming brief prediction Tide Tables, 1870.

Field and office work relating to Tides, 1872.

Tables of 8 place logarithms.

Fonetik Alphabet, 1893.

Fonetik First-book, 1893.

Economic Phonetic Alphabet, 1894.

Phonetic Primer, 1894.

Anti-Fonetik First Book, 1894.

He cut and cast the type, and printed the last six works on his premises. His fonetik system is said to be largely original and of great value.

Stimulated probably by the celebrated bequest of Thomas George Hodgkins to the Smithsonian Institution in 1892, Mr. Avery soon after that event made his will and placed it in the hands of Secretary Langley. He was a member of the National Geographic Society, and of the Philosophical Society of Washington. He died at the age of 86, and was buried in the family burying ground near Norwich, Conn.

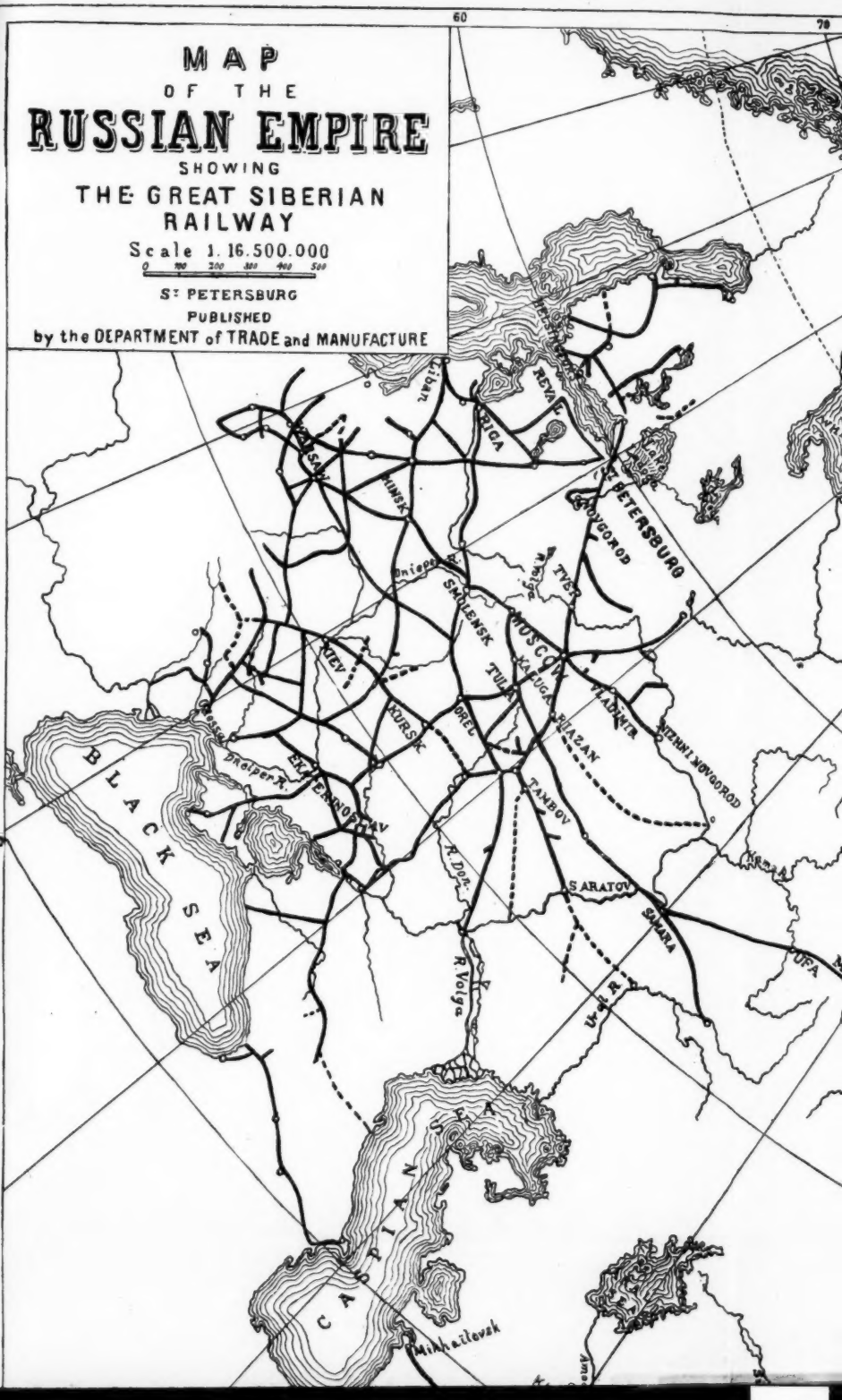
NOTES.—Mr. Jacob Tome has established at Port Deposit, Md., an institution similar in most respects to the Pratt Institute of Brooklyn, the Drexel Institute of Philadelphia and the Armour Institute of Chicago. Ac-

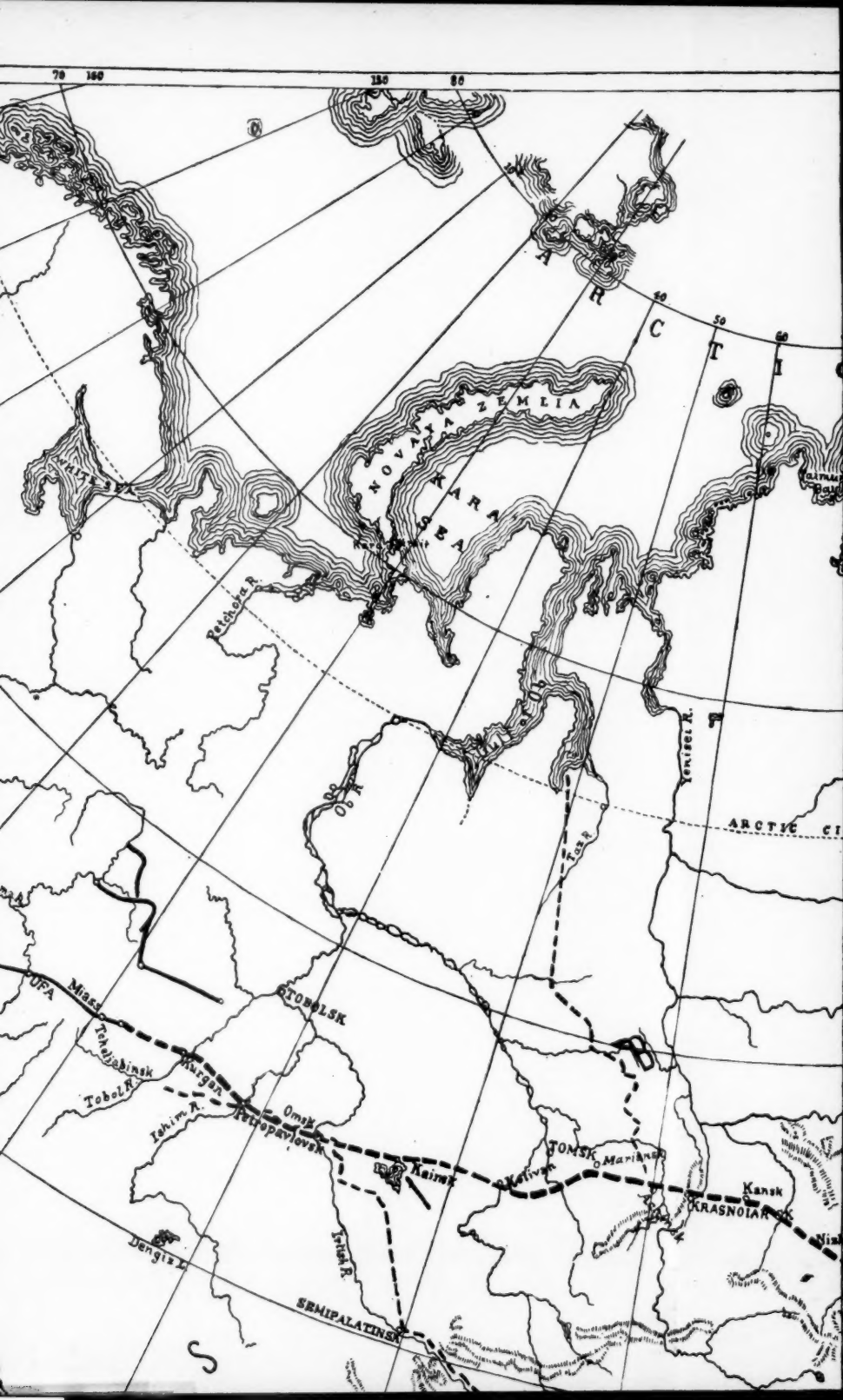
cording to the Baltimore *Sun* there will be a miniature public school system on improved lines and modern methods. Every privilege is absolutely free; but the children of Port Deposit are to be first accommodated, then the children of the County, then the State, and finally the country at large. Like the Pratt, Drexel, Wagner and Armour, the Jacob Tome Institute takes the name of its founder. Building No. 1 is now erected, and has an endowment of one million dollars.

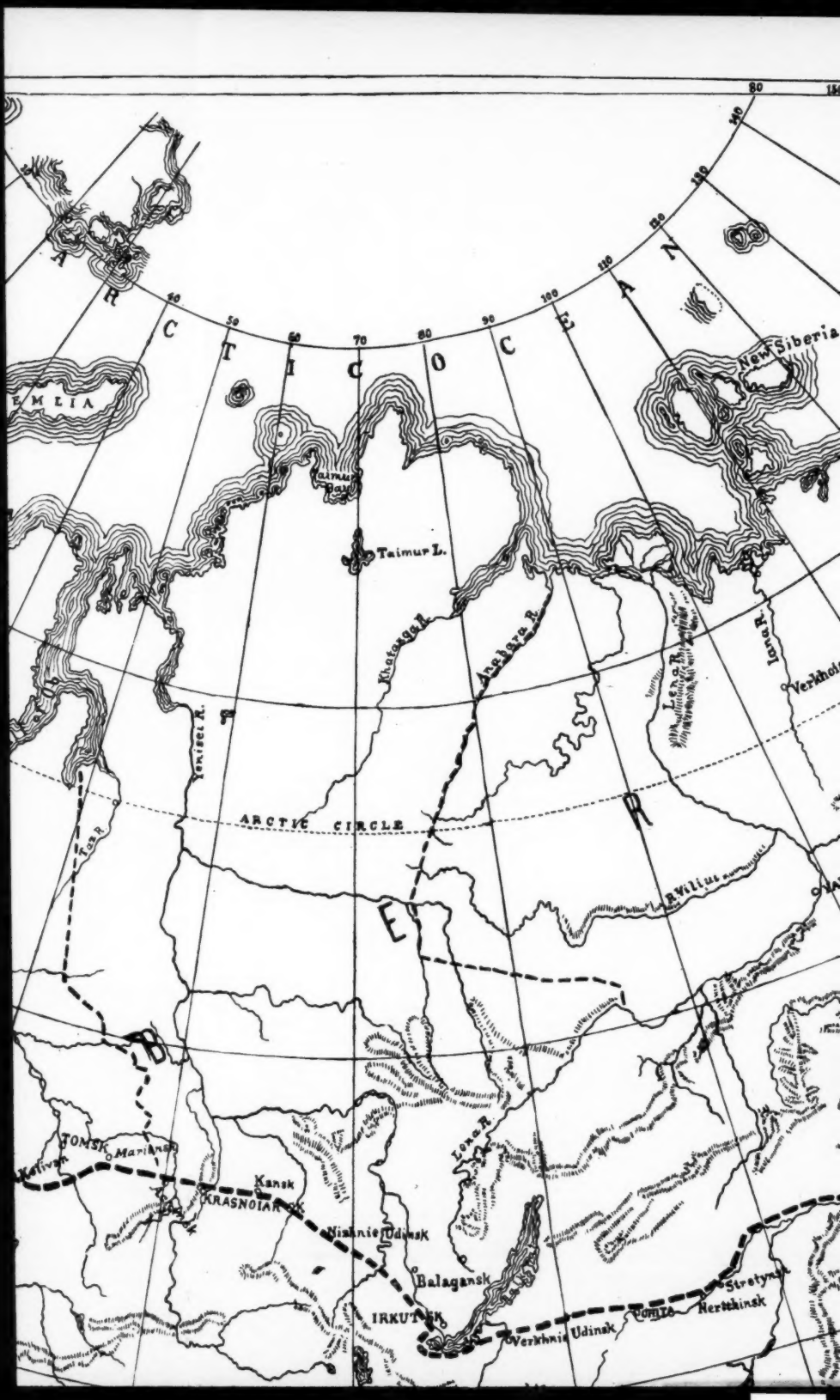
Institutions for the public good, with such massive endowments as the Johns Hopkins University, the Enoch Pratt Free Library and the Jacob Tome Institute give the State of Maryland very high rank for liberal and intelligent dedication of wealth.

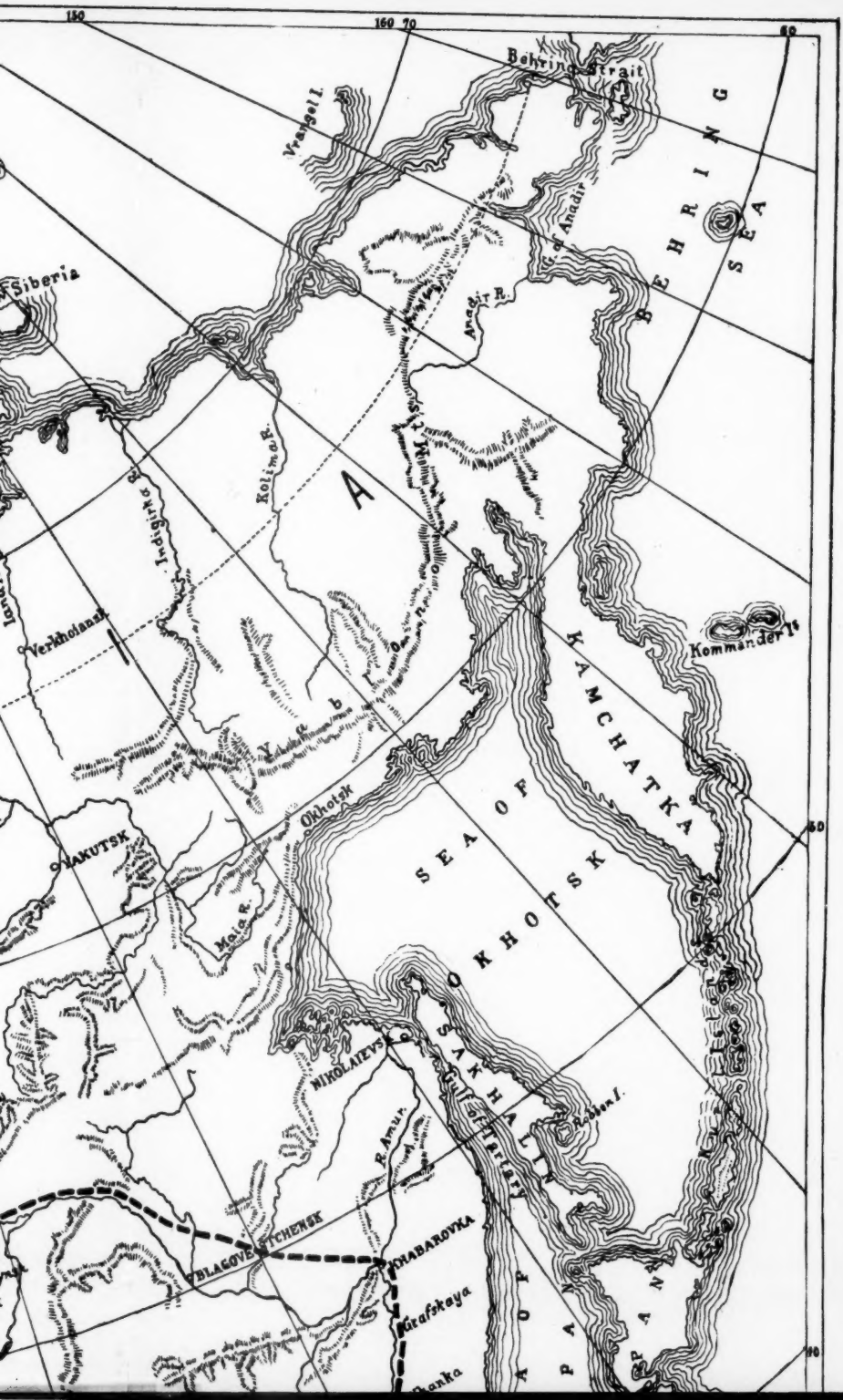
The United States Minister at Constantinople makes a report on the vigorous explorations of the ruins of Niffer, near ancient Babylon, under the direction of American scientists, and provided for by the "Babylonian Exploration Fund." He says that 150, and at times as many as 250 Arabs are employed in the work of excavating. Tons of tablets, vases, inscribed brick, sarcophagi, etc., have arrived at the museum at Constantinople, which is in charge of Dr. Hilprecht, of the University of Pennsylvania, which institution is to be enriched by one of all duplicate antiques.

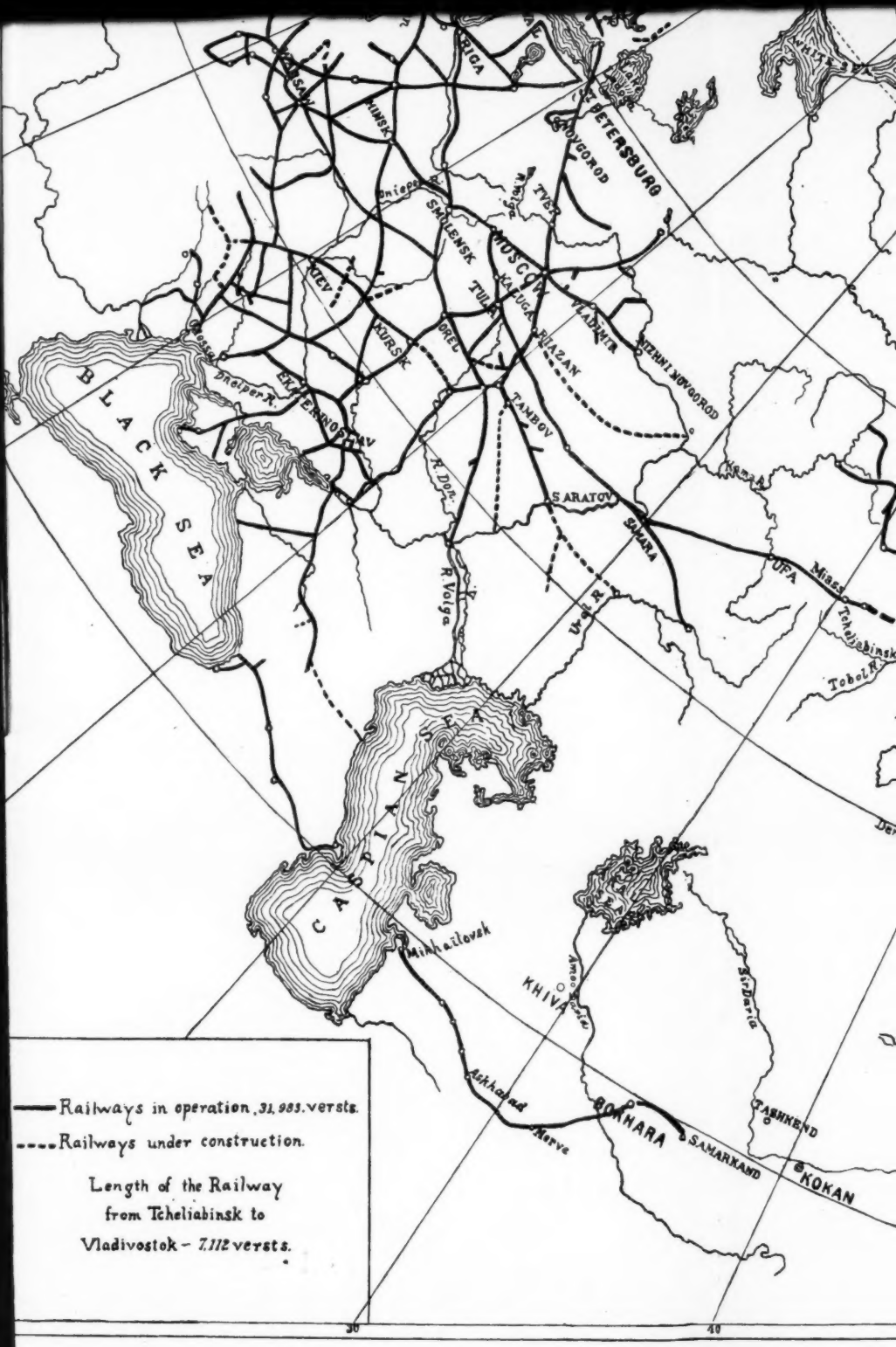
Mr. W. J. McGee and William Dinwiddie, of the Bureau of Ethnology, are exploring the desert country of the southwestern portion of Arizona known as Papagoria, said to be one of the most desolate and least known portions of the United States. The Papagos are said to be the most primitive people on the Western Continent. H.


MAP
OF THE
RUSSIAN EMPIRE
SHOWING
THE GREAT SIBERIAN
RAILWAY
Scale 1.16.500.000
0 100 200 300 400 500
St PETERSBURG
PUBLISHED
by the DEPARTMENT of TRADE and MANUFACTURE
60
70
40
BLACK SEA
CASPIAN SEA
R. Volga
R. Don
R. Dniepr
R. Dwina
R. Ural
RIGA
REVAL
HELSINGFORS
ST PETERSBURG
NOVGOROD
TVER
MOSCOW
VLADIMIR
NIZHNI NOVGOROD
RIAZAN
KALUGA
TULA
SMOLENSK
KIEV
KURSK
OREL
TAMBOV
SARATOV
SAMARA
UFA
KRASNOYARSK
EKATERINOSLAV
Dniepr R.
Dniester R.
Mikhailovsk

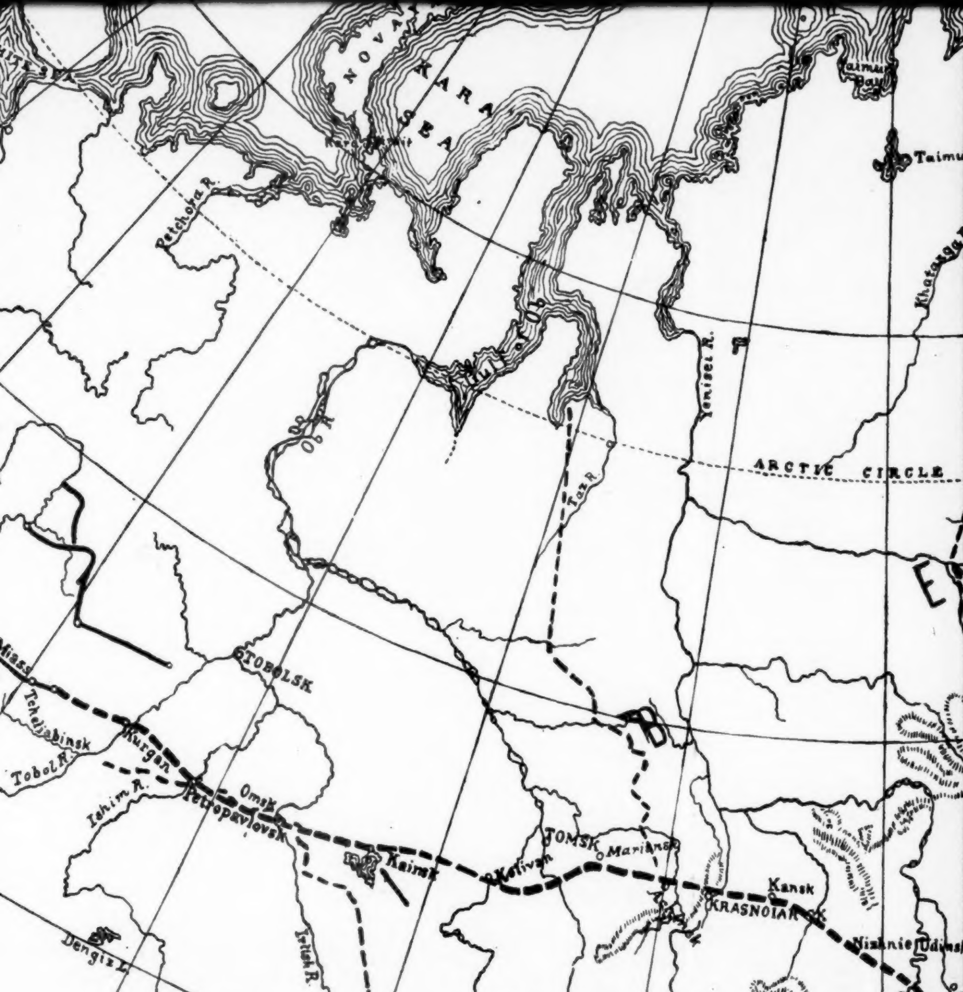

70
160
150
80
ARCTIC
NOVAYA ZEMLIA
KARA SEA
WHITE SEA
Petchora R.
Yenisei R.
ARCTIC CI
UFA
Miass
Tcheliabinsk
Tobol R.
Ishim R.
Kurgan
Omsk
Petropavlovsk
TOBOLSK
Kainsk
TOMSK
Marinsk
Kolivan
Kansk
KRASNOIARSK
Nizh
Irtish R.
Dengiz L.
SEMIPALATINSK


ARCTIC OCEAN
EMLIA
Taimur L.
Khatanga R.
Anabara R.
Lena R.
Yenisei R.
ARCTIC CIRCLE
Ob R.
Vilius
TOMSK
Mariinsk
Kansk
KRASNOIARSK
Nizhnie Udinsk
Balagansk
IRKUTSK
Verkhnie Udinsk
Nertchinsk
Stretynsk
Lena R.

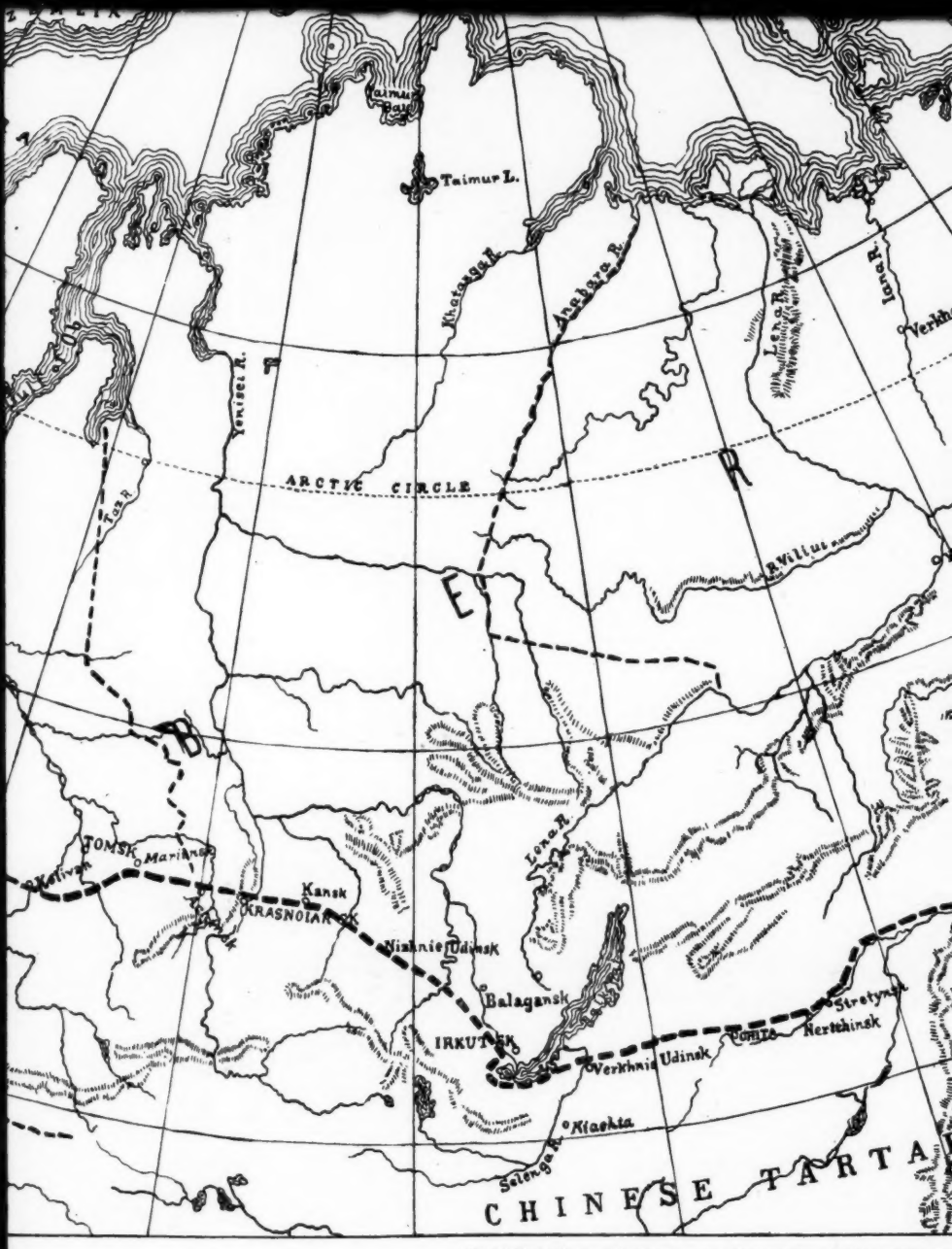

150
160
70
60
Behring Strait
Wrangel I.
BEHRING SEA
Siberia
Anadir R.
Kolima R.
Indigirka R.
Verkhoiansk
Yakutsk
Okhotsk
Maia R.
SEA OF OKHOTSK
KAMCHATKA
Kommander Is
NIKOLAIEVSK
SAKHALIN
Strait of Tartary
R. Amur
BLAGOVESTCHENSK
KHABAROVKA
Kiraffskaya
Ranka
50
90



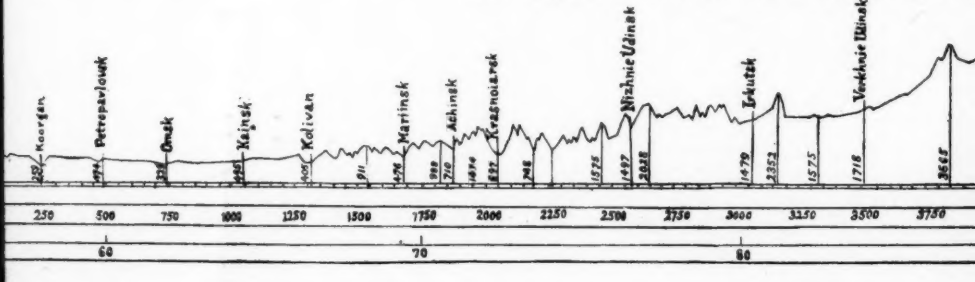
ADAPTED FROM THE MAP IN U. S. CONSULAR REPORTS, NO. 166.

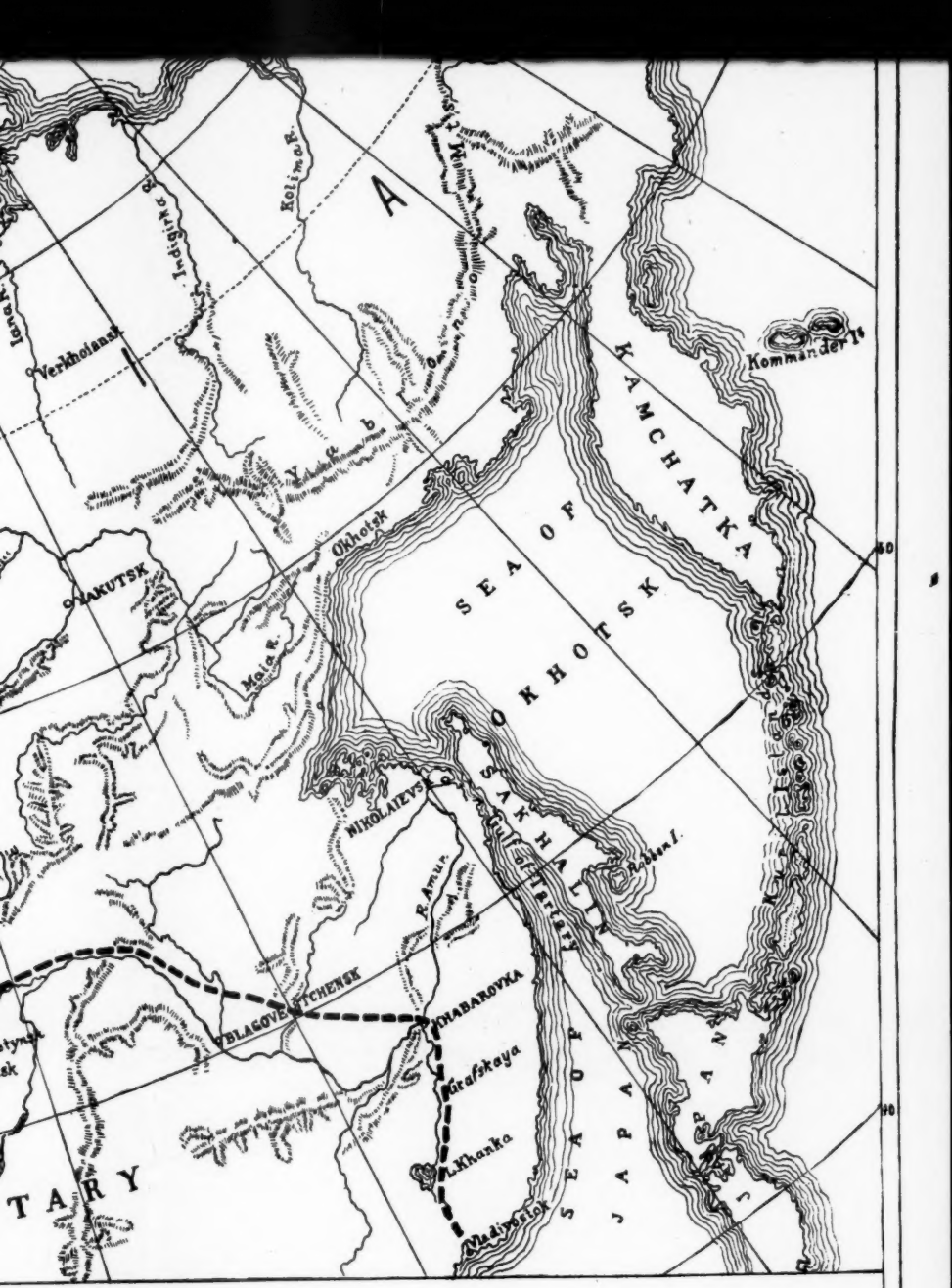


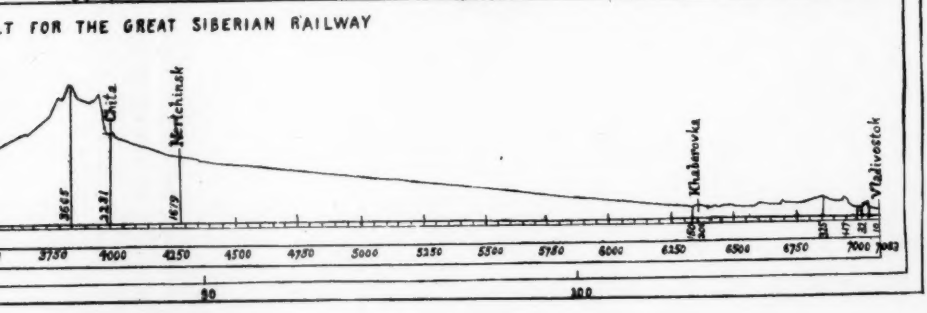
KARA SEA
Kara Strait
Petchora R.
Taimur Bay
Khatanga R.
Yenisei R.
ARCTIC CIRCLE
Taz R.
TOBOLSK
Miass
Tcheliabinsk
Kurgan
Tobol R.
Ishim R.
Omsk
Petropavlovsk
Kainsk
Kolivan
TOMSK
Mariinsk
Kansk
KRASNOIARSK
Nizhnie Udinsk
IRKUT
Irtish R.
Dengiz L.
SEMIPALATINSK
Ili R.
KASHGAR
LONG
Tcheliabinsk
Koorgan
Petropavlovsk
Omsk
Kainsk
Kolivan
Mariinsk
Achinsk
Krasnoiarsk
HEIGHTS IN ENGLISH FEET
Versts
250
500
750
1000
1250
1500
1750
2000
50
60
70



LONGITUDINAL PROFILE OF THE ROAD-BELT FOR TH







THE LONGITUDE IS TAKEN FROM ST. PETERSBURG, 30° 18′ 22.5″ E. OF GREENWICH.